A taxonomic revision of the subgenus *Protandrena* (*Pterosarus*) (Hymenoptera: Andrenidae) in Canada and the United States

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DISCLAIMER

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ABSTRACT

Robinson, Steven. M.Sc. The University of Manitoba. May, 2023. A taxonomic revision of the subgenus *Protandrena* (*Pterosarus*) (Hymenoptera: Andrenidae) in Canada and the United States. Major Professor: Jason Gibbs. *Protandrena* Cockerell subgenus *Pterosarus* Timberlake is the last major group within the North American Andrenidae to have not received a major revision in the United States and Canada, which leaves a large gap in the knowledge of bee biodiversity in the region. The taxonomy of *Pr*. (*Pterosarus*) remains unknown in many areas, particularly in Canada and the American West. In order to rectify this, a revision of *Pr*. (*Pterosarus*) was completed. Species delimitation followed the process of integration by congruence, with morphological, geographical, and ecological used to delimit species. Morphometric data were analyzed using linear discriminant analysis and partitioning around medioids. Forty-six species were revised, sixteen of which are described as new, thirteen names are treated as junior synonyms, and one name has been elevated from subspecific to specific status. Eight new lectotypes are designated, and the previously unknown females of two species are described. Descriptions, floral record tables, distribution maps, images, and keys to the males and females are provided.

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INTRODUCTION

Importance of Taxonomy

Taxonomy serves as the foundation for much of the biological sciences (Costello et al. 2015). Taxonomic research is crucial to understand the relationship between biodiversity and conservation (Nature 2002), and should be considered a priority in biodiversity conservation (Janzen 1994, 1997). Determining the validity of current species concepts and their relative extinction risk requires taxonomic research (Carlton et al. 1999). Taxonomy can be separated into three categories; alpha taxonomy, which is concerned with the discovery and naming of new species, beta taxonomy, which is the classification of taxa (Mayr 1969), especially in light of their evolutionary relationships, and gamma taxonomy which is concerned with infraspecific populations, speciation, and evolutionary subjects. It is estimated that 15000–20000 new species are described each year just among animals (Padial et al. 2010). However, despite these considerable efforts there are only an estimated two million of the conservatively estimated ten million eukaryotic species described (May and Harvey 2009). This lack of description is especially pressing in what has been called "the century of extinctions" (Dubois 2003). Many cryptic species, especially small ones, go extinct without the greater notice of the scientific community (McKinney 1999). This is likely due to the fact that many species are difficult to identify, and often require an experienced taxonomist to identify reliably (Colla et al. 2012). Modern taxonomic research faces a breadth of challenges including: having poor Impact Factor in published works (Boero 2001), poor funding (Packer et al. 2009b), decreasing numbers of taxonomists (Hopkins and Freckleton 2002), and poor recruitment of new taxonomists (Cotterill 1995). Taxonomy of bees is a discipline that has been described as "notoriously difficult" due to the morphological similarity of many species (Paxton 2015). As a result, we still remain largely

ignorant of the conservation status of solitary bees in North America (Brown and Paxton 2009) and the taxonomic status of many groups is incomplete for a variety of reasons.

Taxonomic workflows have become more sophisticated and transparent, leading to a potential renaissance in the field should it have sufficient support. However, adequate support extends beyond funding. In order to properly thrive taxonomy needs to undergo a shift in perception by scientists and embrace new available technologies while retaining its identity. There is a perception of the museums and herbaria in which taxonomists ply their trade as "dusty places" with people working on "dusty" topics, which give little intellectual excitement (Brooke 2000). Taxonomic works are also seen as not necessary, and that some works such as keys and species descriptions do not need to be cited (Packer et al. 2018). Taxonomy is an important discipline with the same rigour as other fields of biology. New technological developments in taxonomy have made delimitation of species less idiosyncratic, but simultaneously prove problematic to the field. Techniques such as DNA barcoding are useful tools but in isolation are insufficient for species delimitation (Lipscomb et al. 2003) and lack the theoretical base of traditional taxonomy (Wheeler 2004).

Speciation and Species delimitation

Speciation requires an isolating mechanism, such as a geographical barrier between populations or an ecological change that prevents gene flow. Allopatric speciation occurs due to a physical barrier, such as the Rocky Mountains, preventing gene flow between populations (Coyne and Orr 2004). Physically isolated populations accrue differences that prevent gene flow when contact is restored. When populations are dependent on a particular food source or host, a switch to a new host may be sufficient to create barriers to gene flow even in the absence of

physical separation. An early case study of sympatric speciation was in the *Rhagoletis pomonella* and *R. cingulata* species, which were driven by shifts in host plant use (Bush 1969).

Species delimitation is the process of recognizing and discriminating species. It should not be based on a single character, but instead requires corroboration of data from a variety of sources (DeSalle et al. 2005; Padial et al. 2010). A single morphological trait such as integumental colour, should not be used to separate taxa as it runs the risk of mistaking intraspecific variation for interspecific differences (Packer et al. 2009a). Species are best delimited when independent characters corroborate each other. One set of data, such as geographical range, can be thought of as the hypothesis, and other data (e.g. morphology, genetics) as tests of that hypothesis. This method of delimitation is known as integration by congruence. Padial et al (2010) described the major tradeoffs of this method namely that integration by congruence often results in more stable taxonomy due to more accurate delimitation. However, because more independent data are needed for integration by congruence it may underestimate the number of cryptic species present. Integration by congruence was chosen as the method of delimitation for this study because it produces more stable taxonomic units.

Bees

Bees are a monophyletic group that arose from apoid wasps approximately 125 million years ago and are likely the sister group of Ammoplanidae (Sann et al. 2021). The most widely accepted classification for bees is based on Michener (2007), who recognized seven extant families, 21 subfamilies, 50 tribes, and approximately 450 genera globally.

Andrenidae is a major family of bees with over 3000 described species across three subfamilies distributed worldwide except Antarctica and Australia (Ascher and Pickering 2020). Andrenids are typically small to medium sized bees with two subantennal sutures and distinct facial fovea (Mitchell 1960). Until recently, Andrenidae was the only major bee family to not have a comprehensive molecular phylogeny. This affected our understanding of classification, and imposed limits on knowledge and understanding on the method and timing of diversification in Andrenidae and its major lineages (Bossert et al. 2022). Two independent phylogenies of the family were published in 2022 (Bossert et al. 2022; Ramos et al. 2022). Both of which provided data about the diversification of andrenids throughout North and South America and the connection of diversification to their distribution from Old World to New World. Currently, there are three accepted subfamilies for Andrenidae: Andreninae (1568 spp.), Oxaeinae (22 spp.), and Panurginae (1430 spp.).

Andrenids are solitary or communal, ground-nesting bees. All andrenids nest in soil and dig their own cells and burrows, either with one terminal cell at the end of each burrow or a series of cells (Michener 2007). In most andrenids, the cells are provisioned with a solid spherical or flattened spherical mass of pollen, upon which an egg is laid, except the species poor Oxaeinae, which lay their eggs upon a viscous mass of pollen (Michener 2007). Andrenids have a variety of host plant relationships and can be floral generalists like many in the genus *Andrena*, or strictly oligolectic, like many *Perdita*.

The subfamily Panurginae occurs in the Nearctic, Neotropical, Palaearctic, and Afrotropical regions (Rozen 1967) and only dispersed to the old world a single time (Bossert et al. 2022). Panurginae is the most generically diverse andrenid subfamily and encompasses 42

genera divided across seven tribes (Bossert et al. 2022), which is more than the other two subfamilies combined. The higher-level classification within Panurginae has proven problematic having been separated into between four and nine tribes, and up to nine subtribes (Bossert et al. 2022). The tribal classification is now recognized as seven tribes with no subtribes. The generic classification remains difficult to resolve and has been problematic for decades (Wood et al. 2022).

The Protandrenini are the most generically diverse tribe in the Panurgines, encompassing approximately 400 species across 10 genera (Ascher and Pickering 2020). Protandrenines are a New World tribe with the most diversity occurring in the temperate and xeric regions of North America. Most Protandrenines are oligolectic (Ramos and Rozen 2014), with varying degrees of specificity. Some host relationships are genus specific such as *Protandrena* (*Anthemurgus*) on *Passiflora,* or broader like the many *Protandrena* (*Pterosarus*) on related genera of Asteraceae. Protandrenines are morphologically similar, small bees with 2 or 3 submarginal cells, and with yellow maculations on the face of males. The systematics of the Protandrenini is relatively poorly studied (Bossert et al. 2022). The biggest challenge in the systematics of Protandrenini is the status of the genera within the group (Ramos 2011). However, most of the recent works on Protandrenines are focused on the status of South American genera. One understudied group within the protandrenines is the subgenus *Protandrena* (*Pterosarus*), which has never seen a major revision.

Pterosarus

Pterosarus alpha-taxonomy

Protandrena (*Pterosarus*) are small black bees ranging in size from five to nine millimetres. All males and occasionally some females (e.g., *Pr.* (*Pt.*) *ornatipes* Cresson (1872) and *Pr.* (*Pt.*) *renimaculata* Cockerell (1896c) females) have distinct yellow maculations on the face. The alpha taxonomy of *Pr.* (*Pterosarus*) remains poorly studied. Forty-four currently valid species are recognized for this group (Hurd 1979; Sheffield and Perron 2014). The species in the eastern United States were revised as *Pseudopanurgus* (*Pseudopanurgus*) and *Ps.* (*Heterosarus*) (Mitchell 1960). Sheffield and Perron (2014) subsequently synonymized three names for this region. Species for Arizona were treated by Timberlake (1967), when he described the genus group. Timberlake also revised the other major subgenera, *Protandrena sensu stricto*, *Pr.* (*Heterosarus*) and *Pr.* (*Pseudopanurgus*) (Timberlake 1973, 1975, 1976). Few taxonomic studies dealt with *Pr.* (*Pterosarus*) species in a comparative sense although keys are available for Nebraska (Swenk, M.H., Cockerell 1907), Colorado (Cockerell 1922),Illinois (Robertson 1922), and the eastern United States (Mitchell 1960).

Beta taxonomy

The genus-group name *Pterosarus* has a complicated classification history. It was first described in 1967 and has since been treated at the generic level (Timberlake 1975; Moure et al. 2007), as a subgenus of three other genus-group names (*Protandrena, Pseudopanurgus*, and *Heterosarus*; Michener 2000, 2007; Michener et al. 1994; Timberlake 1973) or as a synonym of *Pseudopanurgus* (Ascher 2004; Ascher and Pickering 2020). In the nineteenth century, *Protandrena* (*Pterosarus*) species were typically described in the genera *Panurginus* Nylander (1848) or *Calliopsis* Smith (1853). Cockerell (1896) described *Protandrena*, which was erected

due to differences in tongue morphology and labial palpi from *Andrena*. The type species of *Protandrena* is *Andrena maurula* Cockerell (1896), designated by Sandhouse in 1943. *Pseudopanurgus* was then erected for species with the first recurrent vein terminating at the middle of the second submarginal cell, and the second recurrent vein terminating at the end of the cell (Cockerell 1897). The type species of *Pseudopanurgus* by original designation is *Panurgus aethiops* Cresson (1872). The names *Protandrena* and *Pseudopanurgus* were applied to species with three and two submarginal cells, respectively.

Robertson (1902) described the genus and species *Anthemurgus passiflorae*, which specializes on *Passiflora* (Passifloraceae). The monotypic *Anthemurgus* has shorter mouthparts than *Pseudopanurgus sensu stricto*; the glossa is half the length of the prementum and the labial palpus has segments of equal length (Michener 2007). Crawford (1903a) described the genus and species *Protandrenopsis fuscipennis* for a female with a procoxal spine. *Protandrenopsis* was soon after synonymized with *Pseudopanurgus* (Cockerell 1904). Robertson (1918) erected the genus *Heterosarus*, citing more minute sculpturing than what was traditionally considered *Pseudopanurgus*. Females of *Heterosarus* lack the plumose scopal hairs and procoxal projections of females of *Pseudopanurgus s.s*. *Heterosarus* males are differentiated by the broad V-shaped midapical notch of the sixth sternite, not seen in *Pseudopanurgus* s.s., and irregular dorsal margin of the metatibia, which is distinctly sharply edged in *Pseudopanurgus s.s.* males (Michener 2007). The type species of *Heterosarus* is *Calliopsis parvus* Robertson (1892). *Heterosarus* and *Anthemurgus* were later treated as subgenera of *Pseudopanurgus* (Michener 1944). In addition, Michener (1944) included *Protandrena* as a subgenus of the primarily South American genus *Psaenythia* Gerstaecker (1868), which was later followed by Mitchell (1960). *Pterosarus* was first described as a subgenus of *Pseudopanurgus* (Timberlake 1967), with

Calliopsis rudbeckiae Robertson (1895) as the type species. *Pterosarus* was separated from *Pseudopanurgus* s.s. by the lack of spines on the forecoxae of females, and the deep and narrow midapical notch located on the sixth sternite of males. Timberlake (1973) separated *Heterosarus*, *Protandrena*, *Pseudopanurgus* and *Pterosarus* into their own genera upon his revision of *Pseudopanurgus s.s.*. Timberlake subsequently revised *Heterosarus* and *Protandrena* s.s. (Timberlake 1975, 1976). *Pterosarus* was later treated as a subgenus of *Heterosarus* (Ruz Escudero 1987; Michener et al. 1994).

In the twenty-first century, a broader sense of *Protandrena* was developed, distinct from *Psaenythia* (Michener 2000, 2007) that included the subgenera *Pterosarus*, the South American *Parasarus* Ruz, and *Heterosarus* (including *Pseudosarus* Ruz), with *Anthemurgus* and *Pseudopanurgus* s.s. as separate genera. In an unpublished dissertation, Ascher (2004) treated *Pterosarus*, *Anthemurgus*, and *Heterosarus* as synonyms of *Pseudopanurgus*, without any subgenera recognized. Ascher (2004) treated the South American *Parasarus* and *Pseudosarus* at generic rank. Ascher's usage has been widely applied in recent checklists (Scott et al. 2011; Gibbs et al. 2017; Ascher and Pickering 2020) and ecological studies (Fowler 2016; Onuferko et al. 2015). In this context, *Protandrena* (*Pterosarus*) is referred to as the '*rudbeckiae*' species group (Gibbs et al. 2017; Scott et al. 2011). In Ascher's (2004) classification the '*rudbeckiae*' group included *Anthemurgus.* Some recent authors classified *Pterosarus* and *Heterosarus* as subgenera of *Protandrena* (McCabe et al. 2020; Michener 2007; Packer et al. 2007). After considering phylogenies by Ascher (2004), Ramos et al.(2022) and Bossert et al. (2022), *Pterosarus* is classified as a subgenus of *Protandrena* and this is how it is applied below. In Ascher's (2004) phylogeny the genus *Protandrena* was not included and the other phylogenies suggest *Protandrena* and *Pseudopanurgus* are sister taxa. Ramos et al. (2022) found *Pterosarus*

as a monophyletic sister group to *Heterosarus* Bossert et al. (2022) proposed *Protandrena* as the genus name for all North American Protandrenini. The newest global bee checklist by Ascher and Pickering (2022) follows this classification. Ramos et al. (2022), however, treated *Pterosarus* as generic rank. I consider all the remaining Protandrenini, i.e. *Heterosarus*, *Pseudopanurgus*, and *Anthemurgus* are also subgenera of *Protandrena*. Greater taxon sampling might reveal paraphyly of either *Heterosarus* or *Pterosarus* so the status of these names may need to be revised in the future, but using *Protandrena* as an overarching genus will keep a stable name regardless.

Ecology

Protandrena (*Pterosarus*) is a North American subgenus that occurs from Panama to the upper extent of the prairie region in Canada. Like other andrenids, *Pr*. (*Pterosarus*) are all presumed to be ground-nesting bees (Rozen 1989). *Protandrena* (*Pterosarus*) are known to construct simple burrows in flat, sparsely vegetated, rocky soil exposed to direct sunlight (Rozen 1967, 1989). Burrows are approximately 6–30 cm deep and contain 24–26 cells, based primarily on studies of *Pr*. (*Pt.*) *occultata* (as *boylei* Cockerell (1896b)), and *Pr*. (*Pt*.) *occidua* Timberlake (1967) (Rozen 1967, 1989). These nesting habits are similar to other panurgines such as *Pr*. (*Pseudopanurgus*) and *Pr*. (*Heterosarus*) (Pierce 1904; Hicks 1931; Rozen 1965, 1967, 1989; Hurd and Linsley 1972). *Protandrena* (*Pterosarus*) show a distinct preference for flowers in the family Asteraceae (Fowler 2016; Hurd et al. 1980; Mitchell 1960; Robertson 1926). Oligolecty, the use of a limited range of available host species for pollen provisioning, is common in the Andrenidae. Different species of *Pr*. (*Pterosarus*) show preferences for different tribes within Asteraceae. *Protandrena* (*Pt*.) *aestivalis* Provancher (1882) on the tribe Astereae, particularly *Solidago* and *Symphyotrichum* (Fowler 2016), and the aptly named *Pr*. (*Pt*.) *rudbeckiae*

Robertson (1895) on Heliantheae, particularly *Rudbeckia* (Hurd 1979). *Helianthus* seems to be a preferred genus for multiple species (Hurd et al. 1980). There is no indication that *Pr.* (*Pterosarus*) use any other plant family for pollen provisioning.

Objectives and hypotheses

There has never been a comprehensive revision of *Pr.* (*Pterosarus*) west of the Mississippi River or for any part of Canada. *Protandrena* (*Pterosarus*) is the only major group of Andrenidae in the United States and Canada that hasn't been revised at least once. To clarify the taxonomy of *Pr.* (*Pterosarus*), I address the following questions in this study: How many species are within this subgenus? Are any subspecies worthy of recognition? How are species distinguished morphologically? What is the known and potential distribution of these species? I hypothesize that existing taxon concepts within the subgenus are robust in areas that have been well studied (i.e. the Eastern United States). However, some species and subspecies are recognized based on limited material without explicit consideration of other species, so I hypothesize that some names may need to be synonymized. For example, some species were described from Nebraska based on minor differences in colour, which the authors themselves suggested may not be deserving of species status (Swenk and Cockerell 1907). I also suspect that some populations in poorly collected areas may represent undescribed species. There are few studies or records of *Pr.* (*Pterosarus*) in western Canada and I expect that there will be unrecognized diversity in this region.

METHODS

Specimens examined

This study was based on examination of 4709 specimens. Specimens were examined and compared in a variety of characteristics related to surface sculpturing, pilosity, colour, shape, and size. Through an iterative process incorporating geographical range and comparison to available type material, specimens were categorized into 46 putative species and morphospecies.

Specimens and types were examined from the following institutions and individuals:

AMNH = American Museum of National History, New York, New York

ANSP = Drexel Academy of Natural Sciences Philadelphia, Pennsylvania

BBSL = Bee Biology and Systematics Laboratory (USDA), Logan, Utah

BIML = Bee Inventory and Monitoring Lab (USGS), Beltsville, Maryland

BIO = Biodiversity Institute of Ontario, Guelph, Ontario

CAES = Connecticut Agricultural Experimental Station, New Haven, Connecticut

CAS = California Academy of Sciences, San Francisco, California

CESC = Catherine E. Seibert Collection, Bozeman, Montana

CMN = Canadian Museum of Nature, Ottawa, Ontario

CNC = Canadian National Collection of Insects Arachnids and Nematodes, Ottawa, Ontario

CTMI = Central Texas Melittological Institute, Austin, Texas

CUIC = Cornell University Insect Collection, Ithaca, New York

DEBU = University of Guelph Insect Collection, Guelph, Ontario

RJPC = Environmental Solutions & Innovations. (Rob P. Jean), Cincinnati, Ohio

PSUC = Pennsylvania State University Frost Entomological Museum, University Park, Pennsylvania

HBS = Hutchings Bee Service, Vancouver, British Columbia

INHS = Illinois Natural History Survey, Champaign, Illinois

MAPC = Michael Arduser Personal Collection

MEM = Mississippi Entomological Museum, Stackville, Mississippi

MNDNR = Minnesota DNR, Saint Paul, Minnesota

MSUC: RI = A. J. Cook Arthropod Research Collection Michigan State University (Rufus Isaacs), Lansing, Michigan

MTEC = Montana Entomological collection (MTEC), Bozeman, Montana

NDSU = North Dakota State University, Fargo, North Dakota

NHMUK = National History Museum UK, London, UK

OSAC: LP = Oregon State Arthropod Collection (Lauren Ponisio), Corvallis, Oregon

OSUC = C.A. Triplehorn Insect Collection Ohio State University, Columbus, Ohio

OSUC: KG = Ohio State University (Karen Goodell), Columbus, Ohio

PERC = Purdue Entomological Research Collection, West Lafaeyette, Indiana

PMAE = Royal Alberta Museum, Edmonton, Alberta

RMNH = Richter Museum of Natural History University of Wisconsin - Green Bay, Green Bay, Wisconsin

RSKM = Royal Saskatchewan Museum, Regina, Saskatchewan

RUIC: RW = Rutgers University (Rachael Winfree), New Brunswick, New Jersey

SEMC = Kansas University Biodiversity Institute, Lawrence, Kansas

SMIC = South Dakota State University, Brookings, South Dakota

SWRS = Southwest Research Station, Portal, Arizona

TAMUIC = Texas A&M University Insect Collection, College Station, Texas

TOPC = Tom Onuferko Personal Collection

UCMC = University of Colorado Museum Collection, Boulder, Colorado

UCMZ = University of Calgary Museum of Zoology, Calgary, Alberta

UCMS = University of Connecticut, Mansfield, Connecticut

UGCA = University of Georgia Collection of Arthropods, Athens, Georgia

UKIC = University of Kansas Insect Collection, Lawrence, Kansas

ULQ = University of Laval Quebec, Quebec City, Quebec

UMNHC = University of Massachusetts Natural History Collection, Amherst, Massachusetts

UMSP = University of Minnesota Insect Collection, Minneapolis, Minnesota

UNI: AW = University of Northern Iowa (Ai Wen), Cedar Falls, Iowa

UNSM = University of Nebraska State Museum, Lincoln, Nebraska

OMNH: JH = University of Oklahoma (K.L. James Hung), Norman, Oklahoma

MCUR = University of Rochester (Robert Minckley), Rochester, New York

USDA IL = United States Department of Agriculture Illinois, Springfield, Illinois

USDA ND = United States Department of Agriculture North Dakota, Fargo, North Dakota

USNM = United States National Museum, Washington, D.C.

UVM = University of Vermont Museum, Burlington, Vermont

ESUW = University of Wyoming Insect Museum, Laramie, Wyoming

VADCR = Virginia Department of Conservation and Recreation, Richmond, Virginia

WIRC = Wisconsin Insect Research Collection, Madison, Wisconsin

WRME = J. B. Wallis / R.E. Roughley Museum of Entomology, Winnipeg, Manitoba

Delimitation of species

Following the evolutionary species concept, species were considered to be evolutionary distinct lineages. Morphological variation, geographic separation, and different floral host preferences may contribute to separation of lineages along distinct evolutionary trajectories. Species boundaries were delimited using a combination of morphology, geography, and ecological data, such as floral host records. Species delimitation followed integration by congruence, wherein independent data sources must agree in order to recognize populations into separate species

(Padial et al. 2010). Specimens were sorted with morphology using existing keys and reference to type material. Specimens were examined using a Nikon SMZ800N microscope under 20–80× magnification depending on the character being assessed and size of specimen. Specimens were illuminated using either a standard desk lamp with a 9-watt LED bulb set off to the left side, or a microscope-mounted LED ring light (Generic 144-watt MIC-209). Specimens were photographed using a Canon EOS 7D camera equipped with a Canon MP-E 65 mm lens mounted on a Cognisys StackShot Macro Rail using the following settings: method: auto dist – 20 micrometers, 5.0 F stack, ISO 100–160, shutter speed 1/250, and three Speedlite YN560 III flashes arranged approximately 120 degrees from one another centered on the specimen set to 1/16 speed. Images were stitched in Helicon Focus 7 using pyramid stacking as the stacking method. Colour corrections and further editing were done in Adobe Photoshop 2023. I measured 599 individuals, initially categorized into 46 putative species, for 22 quantitative and 5 qualitative variables using a Nikon SMZ800N microscope equipped with an ocular micrometer. Measurement data were analyzed in R version 4.0.5 (R Core Team 2021). Linear discriminant analyses were conducted using leave-one-out cross validation in the R *MASS* package (Venables and Ripley 2002) to determine if measurement data explained existing taxon groups based on qualitative examination of specimens and current taxon concepts. Next, I added qualitative data such as colour and shape of labral process to the dataset. These data were converted to a Gower distance matrix using the R *cluster* package (Maechler et al. 2012), which combines qualitative and quantitative data into a single qualitative value. The Gower matrix was then analyzed using the clustering method partitioning around medioids (PAM) where the number of groups (k) was determined by a silhouette analysis. PAM results were plotted using T-distributed stochastic

neighbour embedding in the R *Rtsne* package (Krijthe 2015). Specimens were reassessed in light of these results and geographical distribution to finalize taxon limits.

Males and females were treated separately in these analyses. All data for each sex were run in the same analysis and subset into different plots for visualization. These subsets were based on a priori shared morphological characters such as puncture density and pronotal lobe colour. Six plots were used for the LDA to allow better visualization of similar groups. The groups differ for males and females because the characters that are used to identify species differ between sexes. The groups used for the LDA of females in each plot are: plot 1) *aestivalis* group, which is defined by very fine sparse scutum punctures (*Pr. aestivalis*, *Pr. albertensis*, and *Pr. nudescens*) and *rudbeckiae* group (*Pr. ehnesae*, *Pr. lutzae*, *Pr. piercei*, and *Pr. rudbeckiae*, which is defined by a prosternal spine, plot 2) *citripes* group, which is defined by dense scutum punctures and dark pronotal lobes (*Pr. citripes, Pr. compositarum, Pr. vicina*) and *solidaginis* group which is defined by a rectangular labral process (*Pr. Renimaculata* and *Pr. solidaginis*), plot 3) *albitarsis* group, which is defined by sparse coarse scutum punctures (*Pr. albitarsis*, *Pr. californica*, *Pr. citrinifrons*, *Pr. leucoptera*, and *Pr. vigvierae*) and *atricornis* group, which is defined by a wide head (*Pr. Atricornis* and *Pr. occultata*), plot 4) *perlaevis* group which is defined by having a long face (*Pr. amor*, *Pr. barberi*, *Pr. bidentis*, *Pr. illustris*, and *Pr. perlaevis*) and *labrosa* group (*Pr. Labrosa* and *Pr. labrosiformis*), which is defined by a strongly narrowed labral process, plot 5) *ornatipes* group which is defined by having dense scutum punctures and yellow pronotal lobes (*Pr. albipes*, *Pr. alveus*, *Pr. andrenoides*, *Pr. ornatipes*, and *Pr. quadrapylae*), plot 6) *didirupa* group, which is defined by very sparse, coarse scutum punctures (*Pr. didirupa*, *Pr. irregularis*, *Pr. prata*, and *Pr. luxsolaris*).

The groups for the males of the LDA are: 1) group 1, which is defined by face not entirely yellow, dense scutum punctures (*Pr. andrenoides*, *Pr. citrinifrons*, *Pr. solidaginis*, and *Pr. vicina*), 2) group 2, which is defined by face entirely yellow, pronotal lobes yellow, mesopleuron punctures dense (*Pr. aestivalis*, *Pr. alveus*, *Pr. boylei*, *Pr. nudescens*, *Pr. piercei*, and *Pr. renimaculata*), 3) group 3 which is defined by face entirely yellow, pronotal lobes yellow, mesopleuron punctures sparse (*Pr. albertensis*, *Pr. ornatipes*, *Pr. planafacialis*, *Pr. quadrapylae*, and *Pr. skeggox*), 4) *perlaevis* group which is defined by a long face (*Pr. barberi*, *Pr. bidentis*, *Pr. illustris*, *Pr. labrosa*, and *Pr. perlaevis*), 5) group 5, which is defined by face entirely yellow, pronotal lobes dark, (*Pr. albipes*, *Pr. chepesepe*, *Pr. citripes*, *Pr. compositarum*, *Pr. didirupa*, *Pr. irregularis*, *Pr. leucoptera*, *Pr. luxsolaris*, *Pr. occultata*, *Pr. prata*, *Pr. rowellae*, and *Pr. vigvierae*), and 6) group 6, which is defined by face not entirely yellow, sparse scutum punctures (*Pr. albitarsis*, *Pr. atricornis*, *Pr. californica*, *Pr. ehnesae*, *Pr. labrosiformis*, and *Pr. rudbeckiae*).

Only two plots were used for PAM analyses as this was sufficient to allow clear visualization of groups. The first plot of each PAM analysis (Figure *6*A, Figure *7*A) contained groups of two or more species that share several morphological characteristics and were more likely to be confused. The second plot of each analysis (Figure *6*B, Figure *7*B) contains the remaining species that do not fit into species complexes, and only share superficial similarities with one another. The species complex groups differ for males and females because the characters that are used to identify species differ between sexes. The complex groups for the PAM analysis of females are: 1) *didirupa* group, which is defined by very sparse, coarse scutum punctures (*Pr. didirupa*, *Pr. irregularis*, *Pr. prata*, and *Pr. luxsolaris*), 2) *perlaevis* group, which is defined by a long face (*Pr. barberi*, *Pr. bidentis*, *Pr. illustris*, and *Pr. perlaevis*), 3) *rudbeckiae*

group, which is defined by a prosternal spine (*Pr. ehnesae*, *Pr. lutzae*, *Pr. piercei*, and *Pr. rudbeckiae*), 4) *atricornis* group, which is defined by a wide head (*Pr. atricornis*, *Pr. dracomons*, and *Pr. occultata*), 5) *labrosa* group, which is defined by a strongly narrowed labral process (*Pr. labrosa* and *Pr. labrosiformis*), and 6) *renimaculata* group, which is defined by a rectangular labral process (*Pr. solidaginis* and *Pr. renimaculata*). The species complex groups for the PAM analysis of males are: 1) *didirupa* group, which is defined the same as in the female (*Pr. chepesepe*, *Pr. didirupa*, *Pr. irregularis*, *Pr. prata*, and *Pr. luxsolaris*), 2) *perlaevis* group, which is defined by a long face (*Pr. amor*, *Pr. barberi*, *Pr. bidentis*, *Pr. illustris*, and *Pr. perlaevis*), 3) *atricornis* group, which is defined by a wide head (*Pr. atricornis*, *Pr. boylei*, *Pr. occultata*), 4) *vicina* group, which is defined by coarse deep scutum punctures and maculations on clypeus, paraocular area, and supraclypeal area (*Pr. citrinifrons*, *Pr. citripes*, and *Pr. vicina*), and 5) *bilobata* group, which is defined by bilobate facial maculations (*Pr. bilobata* and *Pr. skeggox*).

Genital extraction

Specimens were rehydrated in a chamber for 24 hours before genitalia were extracted. After 24 hours in the hydration chamber specimens were tested to ensure they were flexible enough to be worked on without damaging the specimen. Light pressure was applied first to a hind leg and then metasoma. If both flexed easily, then genitalia were extracted. Genitalia were extracted using a size 0 insect pin that was hooked on one end. The pin was inserted into the genital opening, hooked around the hidden sternites and pulled until the genitalia were completely exposed. If the specimens did not adequately hydrate, the final two abdominal segments were removed using a pair of dissection scissors. These segments were then placed in a single well in a ceramic Fisher Scientific 3 well plate filled with a potassium hydroxide solution for 3–5

minutes to clear soft tissue. Once the soft tissue was adequately cleared the segments were teased apart using insect pins until the genitalia were fully removed.

Geographical and ecological data

Specimen labels provide geographical and phenological data and, in some cases, floral records. These data are the basis for the geographic range of species, indications of floral host breadth, and can inform hypotheses of speciation events. Despite its importance, floral data on labels are not always reliable. The individual writing the floral label may not be a reliable botanist, so it is recommended that plant vouchers be taken for accuracy of identification. Bees may visit flowers for nectar that are not used to provision their nests (Chambers 1946), and many labels do not make this distinction. This distinction is important as pollen for larval provisions is the primary basis for host plant specialization, whereas other plants may be used for adult feeding. Because of the host specificity of *Pr*. (*Pterosarus*) knowledge of the plant used to provision pollen is useful for species delimitation. Tables 1–31 outline records of host use in *Pterosarus*. Plant names were changed to modern taxonomic interpretations from original label data using the name checking resource at World Flora Online (WFO 2022). Distribution maps for *Pterosarus* were generated using Maxent version 3.4.0 (Phillips et al. 2022) by importing coordinates for georeferenced specimens. Maxent software predicts a species range using maximum entropy and provides an output subject to the limits of presence data and background information provided. Soil classification for mapping was found from the FAO/UNESCO Digital Soil Map of the World (FAO/UNESCO 2007). Environmental data was obtained from WorldClim and included solar radiation, wind speed, elevation, and 19 bioclimatic variables based on temperature and precipitation (Fick and Hijmans 2017).

Species description

Morphological terms follow standard usage in Michener (2007) and surface sculpture terms follow Harris (1979) Puncture density is given in terms of the range of interspaces (IS) between punctures in units of puncture diameters (PD). Punctures are considered dense if IS < 1 PD, and sparse if IS ≥ 1 PD. Median ocellar diameter (MOD) is used as a general method to contextualize some distances such as the distance from the dorsal margin of facial maculations to the antennal socket or the length of hairs on the body. Hair less than one MOD is considered short, equal to one MOD is considered medium length, and greater than one MOD is considered long. Head length and breadth are determined by the ratio of head length (HL) to head width (HW), a head is considered broad if the ratio is less than 0.9 and is considered long if the ratio is greater than or equal to 0.9. Eye convergence is determined by the ratio of upper ocular distance (UOD) to lower ocular distance (LOD) and is separated into four states: parallel (UOD/LOD = 1), weakly convergent below (UOD/LOD between 1 and 1.1), convergent below (UOD/LOD between 1.1 and 1.2), and strongly convergent below (UOD/LOD > 1.2).

The metapostnotum is classified in 4 states: Not extended (no notable extension toward propodeal pit) (Figure 1A) , weakly extended (stopping <25% of the distance to propodeal pit) (Figure 1B), extended medially (25 – 50% of the distance to propodeal pit) (Figure 1C), and strongly extended medially (>50% of the distance to propodeal pit) (Figure 1D).

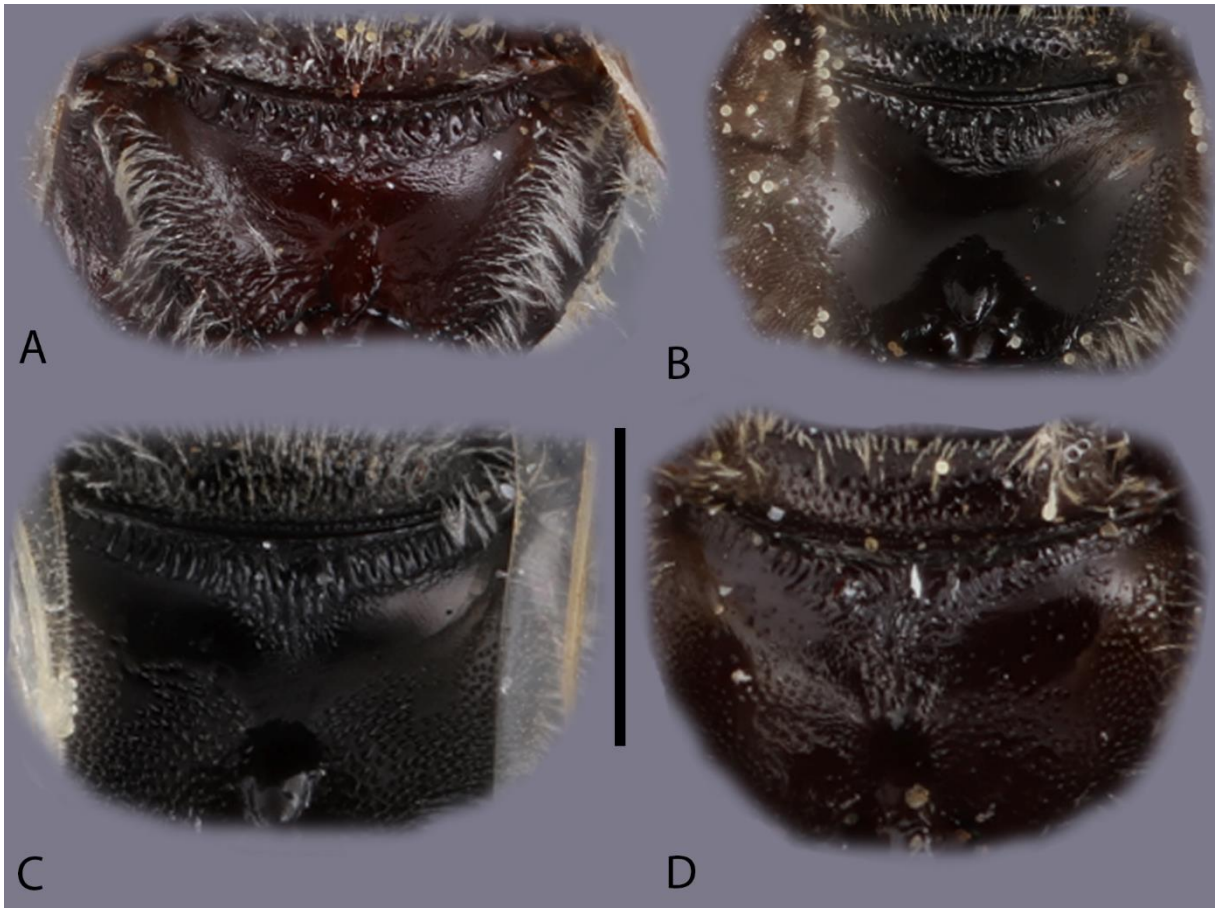


Figure 1. States of the metapostnotum: A. Not extended (*Protandrena* (*Pt.*) *bidentis* ♂). B. Weakly extended (*Protandrena* (*Pt.*) *barberi* ♀), Extended (*Protandrena* (*Pt.*) *leucoptera* ♀), Strongly extended (*Protandrena* (*Pt.*) *nudescens* ♀). Scale bar 0.5 mm.

The shape of the clypeus is classified into 10 states: anchor shaped (Figure 2A), broadly U-shaped (Figure 2B), forked (Figure 2C), narrowly trapezoidal (Figure 2D), quadrate (Figure 2E), rectangular (Figure 2F), semicircular (Figure 2G), trapezoidal (Figure 2H), triangular (Figure 2I), and U-shaped (Figure 2J).

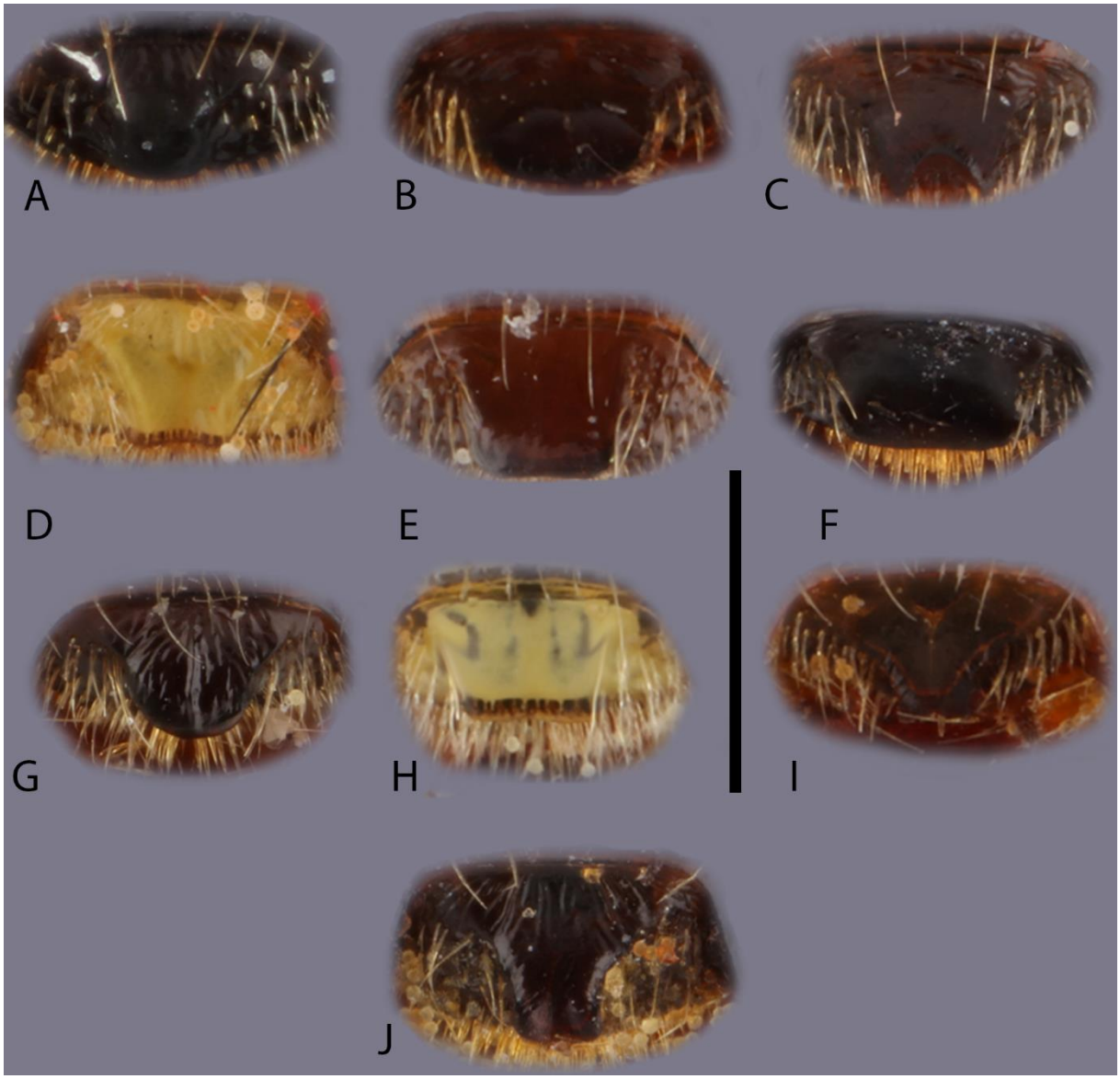


Figure 2. States of the labral process: **A.** anchor shaped (*Protandrena* (*Pt.*) *albitarsis* ♀), **B.** broadly U-shaped (*Protandrena* (*Pt.*) *irregularis* ♀), **C.** forked (*Protandrena* (*Pt.*) *barberi* ♀), **D.** narrowly trapezoidal (*Protandrena* (*Pt.*) *perlaevis* ♂), **E.** quadrate (*Protandrena* (*Pt.*) *occidua* ♀), **F.** rectangular (*Protandrena* (*Pt.*) *renimaculata* ♀), **G.** semicircular (*Protandrena* (*Pt.*) *albertensis* ♀), **H.** trapezoidal (*Protandrena* (*Pt.*) *aestivalis* ♂), **I.** triangular (*Protandrena* (*Pt.*) *labrosiformis* ♀), **J.** U-shaped (*Protandrena* (*Pt.*) *perlaevis* ♀). Scale bar 0.5 mm.

Finally, tarsi 2–4 are classified in 4 states: triangular (Figure 3A), inflated (Figure 3B), asymmetrically inflated (Figure 3C), and conical (Figure 3D).



Figure 3. States of the fore tarsi: **A.** triangular (*Protandrena* (*Pt.*) *ornatipes* ♂), **B.** inflated **(***Protandrena* (*Pt.*) *citrinifrons* ♂), **C.** Asymmetrically inflated (*Protandrena* (*Pt.*) *skeggox* ♂), **D.** Conical **(***Protandrena* (*Pt.*) *andrenoides* ♀). Scale bar 0.5 mm.

RESULTS

Morphometrics

Linear discriminant analysis recovered clusters only partially congruent with initial species assignments. The most morphologically distinct species such as *Pr. atricornis*, *Pr. perlaevis*, and *Pr. piercei* (Figure 4 ACD, Figure 5 BDF) were found as discrete clusters. In both the male and female *Pr. perlaevis* forms a single discrete cluster from across its range, the analysis does not support separation into four species as the synonyms suggest. The *perlaevis* group of females (Figure 4D) cluster along prior species boundaries but the males (Figure 5D) do not, and instead

show overlap in the morphologically similar *Pr. bidentis* and *Pr. illustris*. The *didirupa* group of females (Figure 4F) have well-spaced clusters, indicating that the species are highly variable in morphometric characters. Initially *Pr. rudbeckiae* and *Pr. ehnesae* were both identified as *Pr. rudbeckiae* but formed to two discrete clusters in both the PAM and LDA analyses. As a result, specimens were re-examined and consistent morphological differences were found which suggests that they are separate species. Females (Figure 4) on average have more overlap in the LDA than males (Figure 5), which corresponds to the fact that females of *Protandrena* (*Pterosarus*) are on average more similar morphologically than males.

Partitioning around medioids analyses (Figure 6, Figure 7) were more successful at accurately clustering species, but also encountered issues when applied to morphologically similar species. Twenty-one of the forty-one males and twenty of the thirty-nine females were assigned with no overlap. The PAM analysis for the females showed a difference in the clustering of specimens of *Pr. bidentis* specimens south of the USA/Mexico border (Figure 6A). This suggests that the bidentate labral process group contains some cryptic species that may be difficult to identify. The analysis didn't separate some of the more morphologically similar species. *Protandrena perlaevis* does not fully separate from *Pr. illustris* but the overlap is one specimen almost exactly in between both clusters (Figure 6A). *Pr. didirupa* did not separate completely from *Pr. prata* new species but the location of the specimens in the ordination that were not accurately assigned is more in line with the other specimens of *Pr. didirupa* (Figure 6A). *Protandrena dracomons* new species clustered with *Pr. lutzae* but the data point was far from the rest of the cluster, which suggests that the clustering may not be suitable for a species group (Figure 6A). There is also weak overlap between *Pr. lutzae* and *Pr. rudbeckiae* both of which are similar in size and share a conical projection on prosternum (Figure 6A). *Protandrena*

rudbeckiae and *Pr. ehnesae* were originally thought to be the same species, but these analyses suggested otherwise and upon reexamination suitable morphological characteristics were found to justify separation (Figure 6A). *Protandrena subtilis*, *Pr. vicina*, and *Pr. vigvierae* cluster out together, but exhibit notable separation. The clustering of these species is likely due to the lack of data associated with them; all are known from a single specimen except *Pr. vicina* which is known from two (Figure 6B). *Protandrena ximenesiae* clusters with *Pr. albertensis* likely due to shared qualitative characters (sparse scutum punctures and broad impunctate space on posterior face of propodeum) but shows clear separation from the rest of the cluster (Figure 6B). *Protandrena nudescens* is mixed between the clusters for *Pr. aestivalis* and *Pr. citrinifrons* to which it is most similar (Figure 6B). The analysis suggests that *Pr. nudescens* and *Pr. aestivalis* may be the same species, but they differ in mesopleuron puncture density, scutum pilosity, and location. *Protandrena aestivalis* is a Northeastern species, and *Pr. nudescens* is a Southwestern species. *Protandrena albipes* forms a cluster with *Pr. alveus* but shows clear separation from the rest of the cluster which suggests that it is not the same species.

The PAM analysis for males shows some of the same difficulty that the analysis of females had in discriminating morphologically similar species. *Protandrena amor* clusters out with *Pr. perlaevis* but the data point is noticeably separate from the rest of the cluster (Figure 7A). *Protandrena bidentis* forms a cluster with *Pr. illustris*, to which it is quite similar, but the data points for *Pr. bidentis* are separate from the rest of the cluster (Figure 7A). *Protandrena vicina* forms a cluster of its own but also has specimens that cluster with *Pr. didirupa* (Figure 7A). Overall, the datapoints for *Pr. vicina* are widely spread suggesting either wide variation of the species, or unknown diversity. Re-examination of the *Pr. vicina* specimens showed no notable morphological differences between them. *Protandrena vicina* have much denser

mesoscutum punctures than *Pr. didirupa* and have less yellow maculation on face. *Protandrena prata* forms a cluster with *Pr. didirupa* but the datapoints are separate from the rest of the cluster (Figure 7A). *Protandrena didirupa* and *Pr. prata* are very similar morphologically but *Pr. prata* have punctures of only one type, and yellow on scape and underside of flagella. Surprisingly *Pr. luxsolaris* forms a cluster with *Pr. citripes*, despite being quite different morphologically (Figure 7A). *Protandrena luxsolaris* have much sparser punctures on scutum (IS = 1 PD) which are finely reticulate in *Pr. citripes. Protandrena chepesepe* forms a cluster with *Pr. irregularis* to which it is similar (Figure 7A). The data point is notably separated from the rest of the cluster, which suggests it is different. Males of *Pr. chepesepe* have a longer head (HL/HW ratio 0.94), sparser clypeus punctures (IS > 1 PD), and a narrower impunctate region on posterior face of propodeum. *Protandrena solidaginis* forms a cluster with *Pr. labrosiformis* to which it is only weakly similar, the datapoints for the remaining specimens of *Pr. solidaginis* are close to those that are contained within the *Pr. labrosiformis* cluster (Figure 7B). *Protandrena labrosiformis* differs from *Pr. solidaginis* in having a trapezoidal labral process, a narrower head (HL/HW ratio 0.96), sparser scutellum punctures medially (IS >1 PD) and much less yellow maculation on the face. *Protandrena quadrapylae* forms a cluster with *Pr. nudescens*. It is worth noting that despite coming out in the same cluster in the males (Figure 7B) the females form separate clusters (Figure 6B). *Protandrena alveus* also forms a cluster with *Pr. nudescens* (Figure 7B), but just as in the previous case the females form separate and distinct clusters (Figure 6B). *Protandrena vigvierae* forms a cluster with *Pr. albipes* and is very similar morphologically, but the datapoint is far away from the *Pr. albipes* specimens. *Protandrena vigvierae* have dark scapes, more strongly defined medial and parapsidal lines, a very strongly wrinkled metapostnotum, and are much more weakly pubescent. *Protandrena occidua* and *Pr. ornatipes* overlap one another in

their clusters, though notably at the ends of both their clusters (Figure 7B). It is also worth noting that the females form well separated clusters (Figure 6B). Just as in the females *Protandrena rudbeckiae* and *Pr. ehnesae* were originally thought to be the same species, but these analyses suggested otherwise and upon reexamination suitable morphological characteristics were found to justify separation (Figure 7B). *Protandrena planafacialis* also forms a cluster with *Pr. rudbeckiae* which is likely due to the fact the two species share a flattened face. *Protandrena planafacialis* differs from *Pr. rudbeckiae* by having denser scutum punctures (IS < 1 PD), dark flagella, and no impunctate median line on T1.

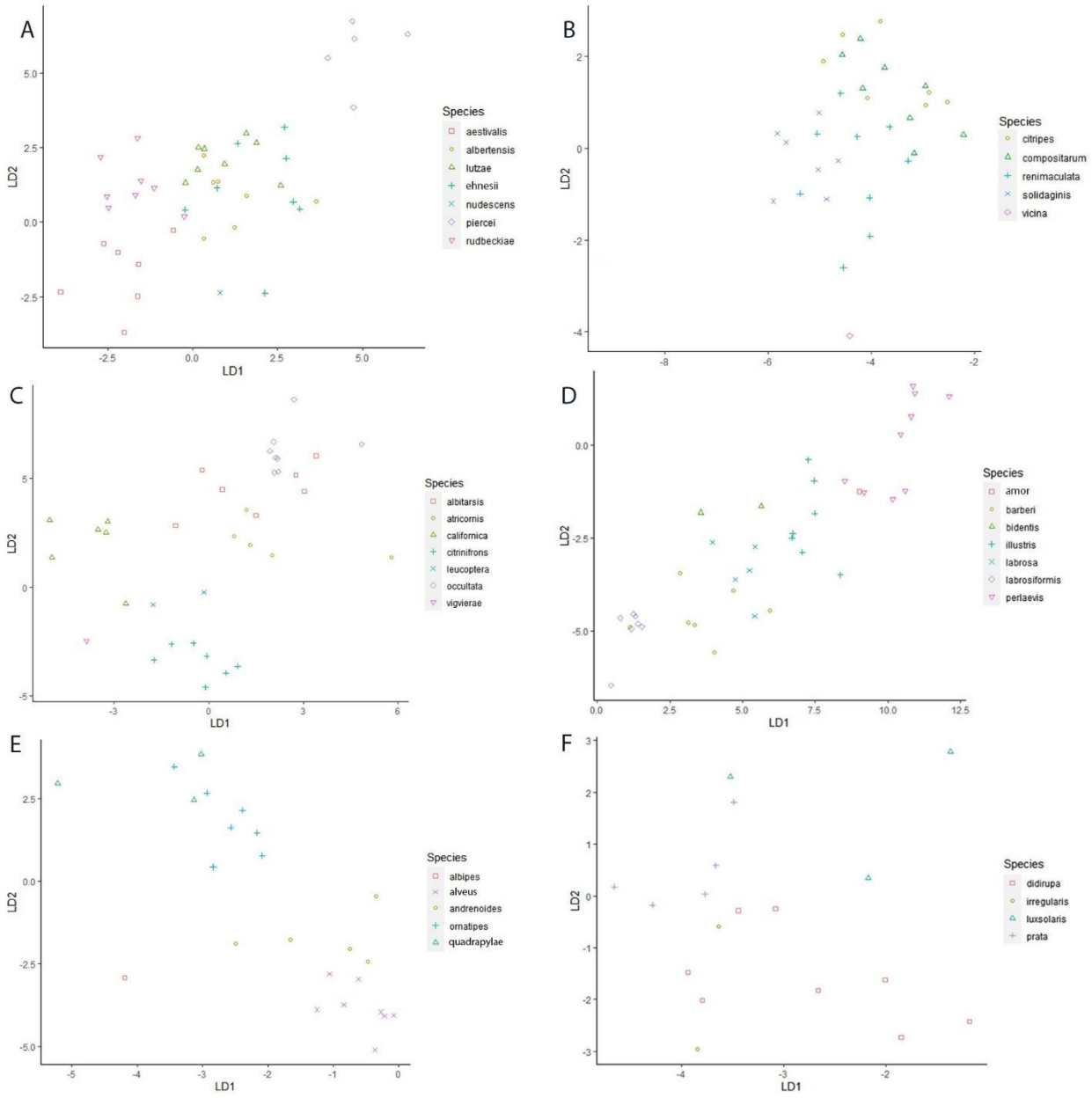


Figure 4. Linear discriminant analysis plots of morphometrics for females. Groups are comprised of the following: A: *aestivalis* group and *rudbeckiae* group, B: *solidaginis* group and

renimaculata group, C: *albitarsis* group and *atricornis* group, D: perlaevis group and labrosa group, E: *ornatipes* group, F: *didirupa* group.

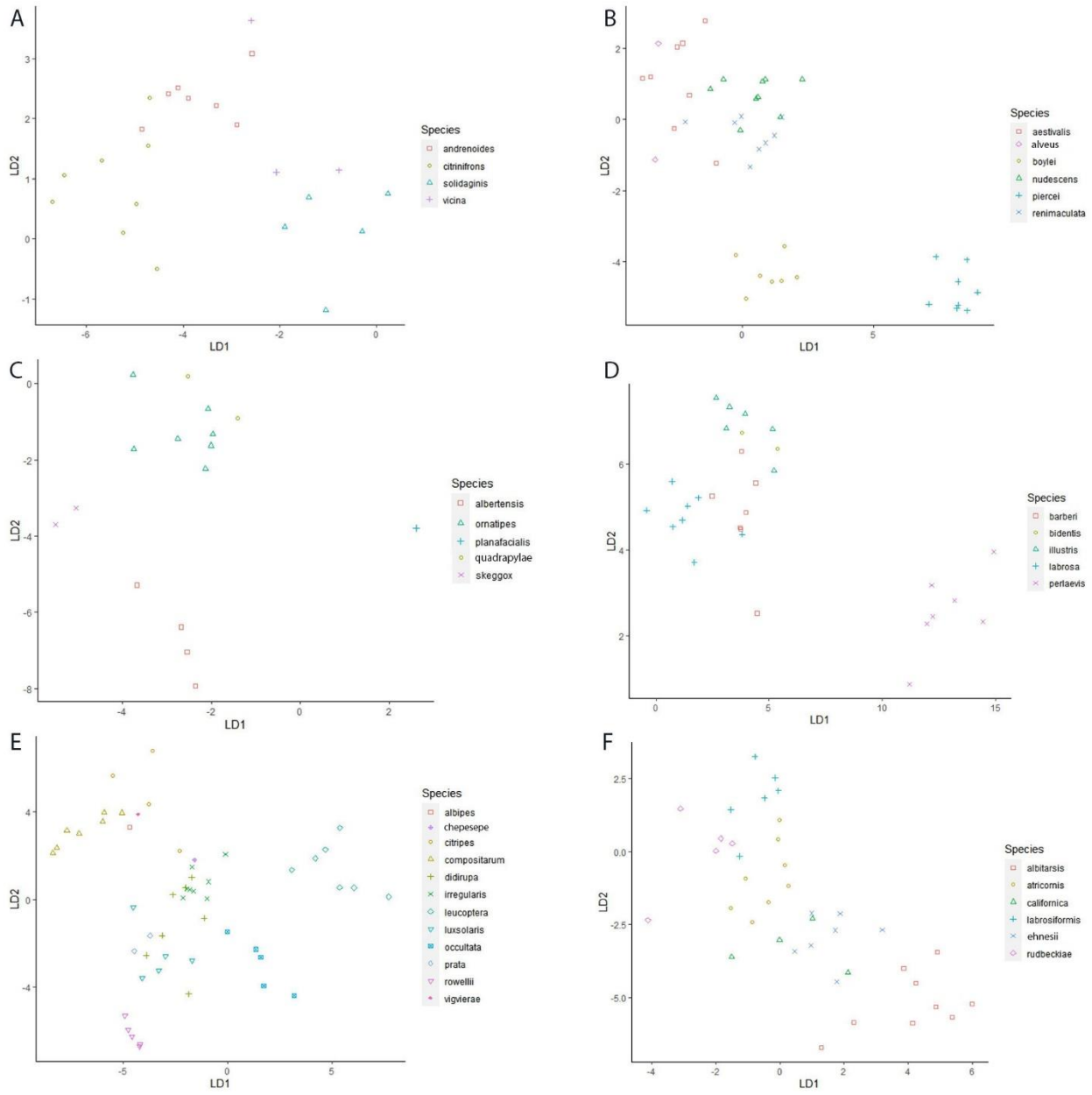


Figure 5. Linear discriminant analysis plots of morphometrics for males. **A**: group 1, **B**: group 2, **C**: group 3, **D**: perlaevis group, **E**: group 5, **F**: group 6.

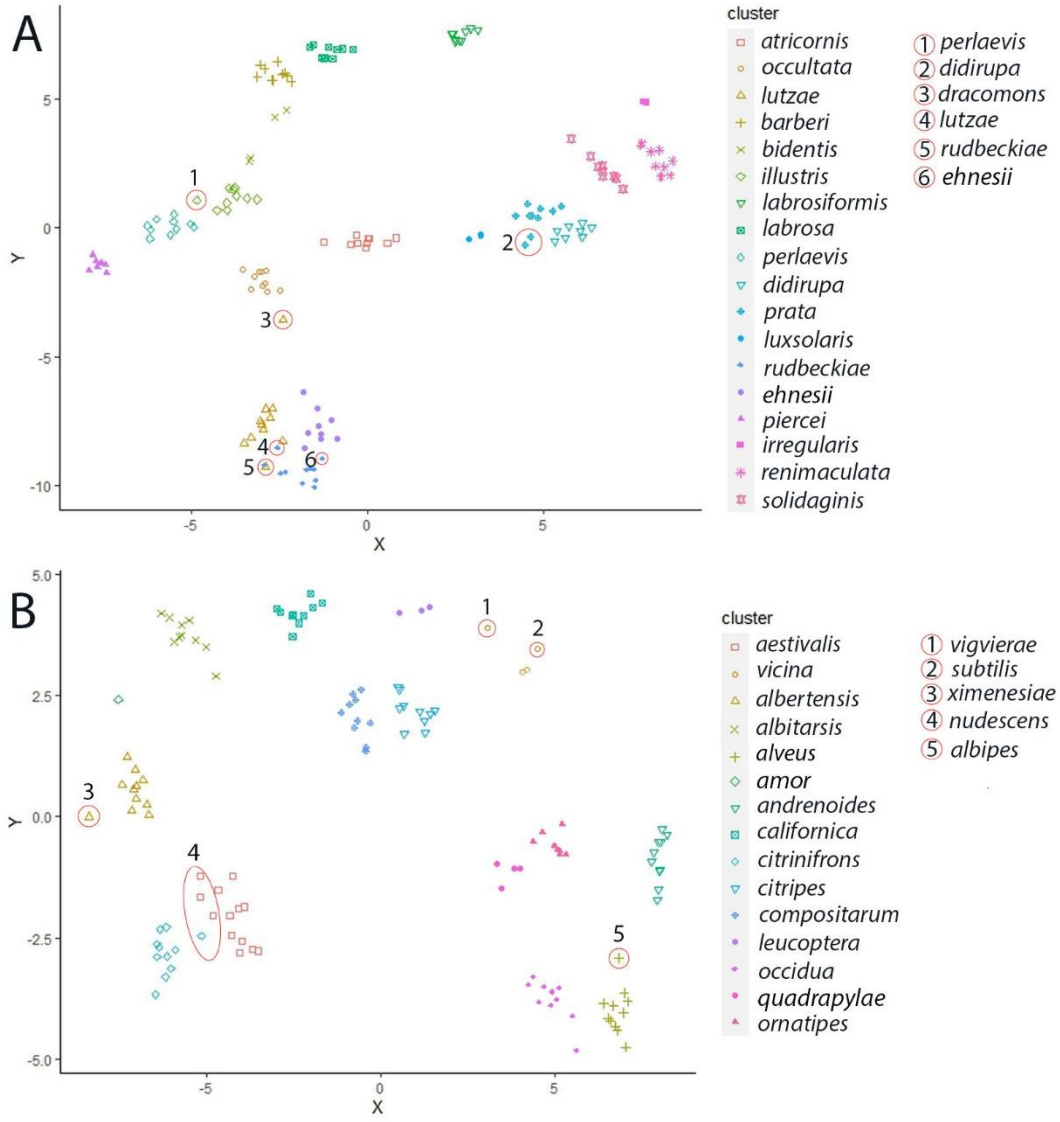


Figure 6. Partitioning around medioids plot for females. **A**: species complexes with distinct morphological similarities (i.e. *perlaevis* group, *didirupa* group etc.) **B**: species not in complexes that share no similarities or only superficial ones.

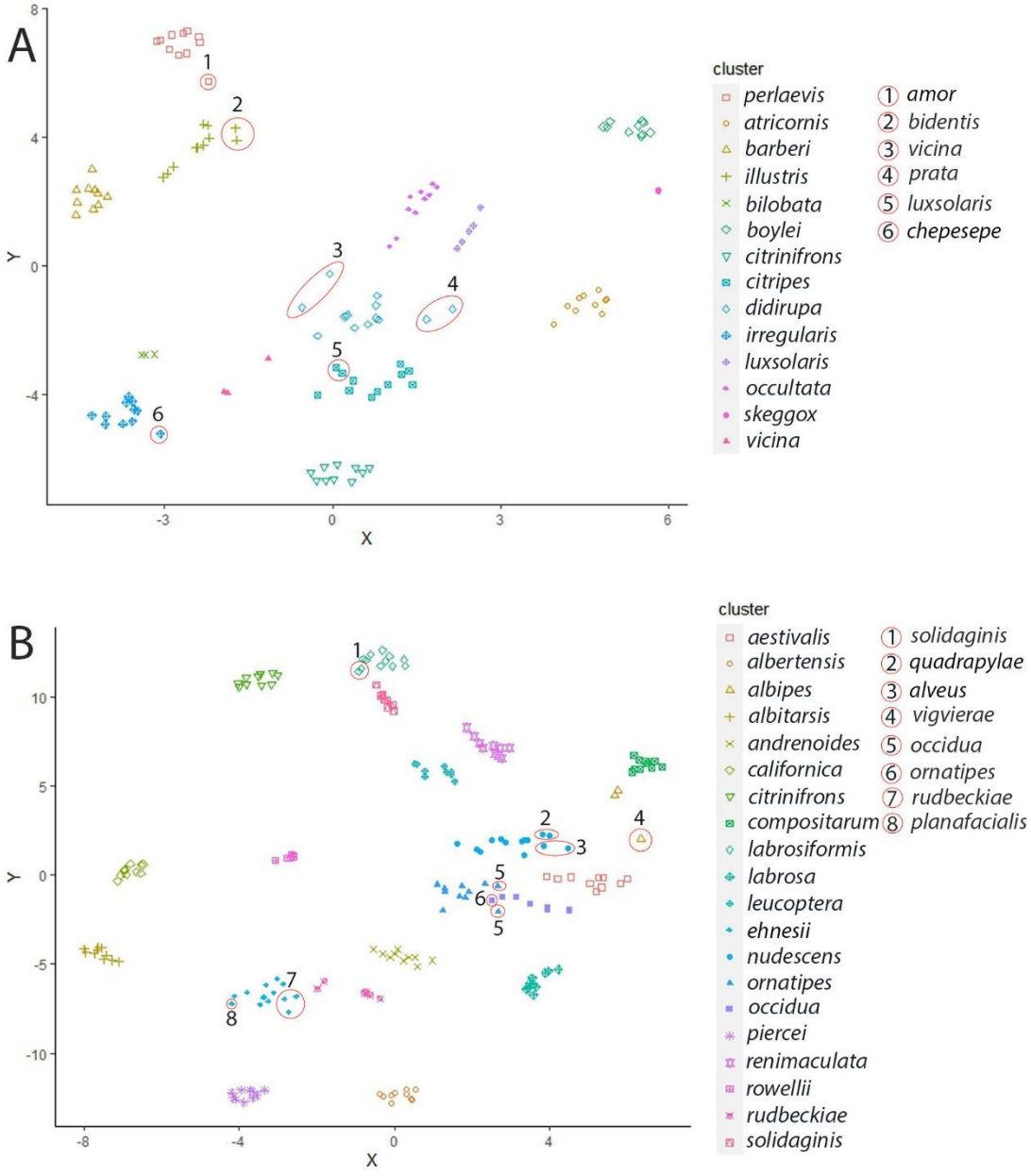


Figure 7. Partitioning around medioids plot for males. **A**: groups of two or more species with distinct morphological similarities that make them hard to differentiate (i.e. *perlaevis* group, *didirupa* group etc.) **B**: species not in complexes that share no similarities or only superficial ones.

DISCUSSION

By providing the first comprehensive revision of *Protandrena* (*Pterosarus*) across the United States and Canada this paper seeks to address the last major gap of taxonomy in Andrenidae in North America north of Mexico. There are 46 recognized taxa within Protandrena (Pterosarus), all of which are at the specific level, keys have been provided to separate the species morphologically and distribution maps have been provided to determine where these species occur. Taxonomy of bees is a discipline that has been described as "notoriously difficult" due to the morphological similarity of many species (Paxton 2015). As a result, we remain largely ignorant of the conservation status of solitary bees in North America (Brown and Paxton 2009) and the taxonomic status of many groups is incomplete for a variety of reasons, such as being known from only one sex. Taxonomy serves as the foundation for much of the biological sciences (Costello et al. 2015). Determining the validity of current species concepts requires taxonomic research (Carlton et al. 1999). Many species are difficult to identify, and often require an experienced taxonomist to identify reliably (Colla et al. 2012). As a result, there is an average "shelf life" of 21-year s between when a new species is first collected and when it is formally described. This lag is due to the lack of specialists and lack of specimens required to make stable delimitations (Fontaine et al. 2012). For the new species of *Protandrena* (*Pterosarus*) described in this thesis, the average shelf life is 56 years. Museums, which retain this undescribed material, remain a crucial part of the biological sciences as specimen repositories and "biobanks" housing countless numbers of specimens that can be used in genetic studies (Yeates et al. 2016) and future taxonomic revisions. Additionally, museum specimens can be used to illustrate differences in population size over time, (Wandeler et al. 2007) and in reconstructing the history of biological invasion events (Marsico et al. 2010).

An integrative taxonomic approach following DeSalle et al (2005) was undertaken to resolve the status of species within *Pr.* (*Pterosarus*) involving the use of morphometric measurements/morphological characters, and ecological data. Forty-six species of *Pr.* (*Pterosarus*) are recognized in North America North of Mexico. Sixteen species are described as new, thirteen names are considered junior synonyms, and one name has been elevated from subspecific to specific status. As expected, the status of names in the Eastern region of the United States were robust, with only one cryptic species being found under a separate species name. Species names in the West however were more problematic, and synonymies occurred primarily in western species. Additionally, most newly described species occurred in the American Southwest, which is a well sampled region, contrasting my prediction that most unknown diversity would be from poorly sampled regions. An explanation for this could be that although the region is well sampled, the lack of taxonomic knowledge of *Protandrena* (*Pterosarus*) resulted in species that were collected but never described. Finally, three new species were found from the Canadian West, confirming my suspicion that this area held unknown diversity.

Linear discriminant analysis and partitioning around medioids were used to analyze morphometric data. Linear discriminant analyses often struggled to independently cluster individual species, but PAM analyses were useful in separating cryptic taxa such as *Pr. rudbeckiae* and *Pr. ehnesae*, and in synonymizing taxa that were otherwise deemed separate such as *Pr. porterae* and *Pr. innuptus* as junior synonyms of *Pr. albitarsis*. PAM used in conjunction with LDA was a useful tool for morphometric analysis, LDA was used to test the validity of the existing species concepts, and PAM suggested groups based on the data provided. Both played

an important role in the delimitation of species and ultimately the PAM analysis proved the more useful of the two in providing clear estimates of species boundaries.

An element that could have seen use within this study would be DNA barcoding. Sheffield et al. (2009) found DNA barcoding useful in clarifying taxonomy of bees, including resolving sex associations and in settling difficult species complexes. Barcodes of *Pr.* (*Pterosarus*) are few and far between and would be useful in species delimitation and for understanding the broader relationships of the species within the group. However, DNA barcoding of *Pr.* (*Pterosarus*) can be difficult as many specimens are old and DNA extraction can be difficult on older specimens. With greater taxon sampling, ultra-conserved elements (UCEs) could be used to produce a comprehensive phylogeny (Bossert et al. 2022), while also generating more DNA barcodes for species level identification.

Additionally, there is a gap in knowledge of some species. Some are poorly sampled occurring from only a handful of collection events/locations such as *Pr. labrosiformis* or consisting of only a small number of specimens. Eleven species are known from only one sex. An increase in sampling efforts may help rectify these issues, but due to the rarity of *Pr.* (*Pterosarus*) even targeted sampling efforts can prove unsuccessful. It is worth noting that some species have not been recorded for decades, such as *Pr. labrosiformis*.

CONCLUSION

In this study, I provide full descriptions and diagnoses for every species with detailed photographs. Floral associations are summarized for each species based on available data and predictive range maps are provided. These two provide a baseline understanding of the habitat requirements of the species. Vaudo et al. (2015) found that floral host conservation is crucial to

the conservation of bees. By understanding the floral host preferences of *Pr.* (*Pterosarus*) conservation efforts of their hosts can be undertaken, ultimately assisting in their conservation. A dichotomous key is provided for both sexes of all USA and Canadian species of *Pr.* (*Pterosarus*). The availability of a dichotomous key for identification will assist in the conservation of *Pr.* (*Pterosarus*) by allowing accurate species estimations for regional bee checklists. Prior to this study, there was no comprehensive resource for identification of these bees and as a result some faunal studies have struggled to accurately identify *Pr.* (*Pterosarus*), or confirm the determinations of others (Gibbs et al. 2017). Future work on *Pr.* (*Pterosarus*) would include taxonomic study of Neotropical species, preferably with a comprehensive use of molecular data, such as DNA barcodes to further test species limits within the subgenus. There is very little known about the Mexican and Central American representatives of *Pr.* (*Pterosarus*) including several potentially undescribed species, which would benefit from a revision of their own. A robust phylogeny is still needed to determine its relationship to *Pr.* (*Heterosarus*) and other subgenera.

Systematics

***Protandrena* (*Pterosarus*)**

Pseudopanurgus (*Pterosarus*) Timberlake, 1967: 10. Type species: *Calliopsis rudbeckiae* Robertson 1895 by original designation.

Taxonomy: Ashmead 1899: 85, classification, key to genera, as *Panurginus* (in part). – Michener and Michener 1951: 1098–1101, catalogue, as *Pseudopanurgus* (*Heterosarus*) (in part). – Rozen,

1966: 5–8, Figs 1–8, larvae, as *Pseudopanurgus*. – Timberlake, 1973: 1, taxonomic status as genus *Pterosarus*. – Hurd 1979: 1856–1859, catalogue, as *Pterosarus*. – Ruz 1987: 38–40, dissertation, diagnosis and description, as *Pterosarus*. – Michener et al., 1994: 173, taxonomic status as *Heterosarus* (*Pterosarus*). – Michener, 2000: 270, taxonomic status as subgenus of *Protandrena*. – Ascher, 2004: 191, dissertation, synonymy with *Pseudopanurgus*. – Michener, 2007: 281, classification as *Protandrena* (*Pterosarus*). – Ramos, 2011. 23–28, dissertation, classification as *Pterosarus*. – Bossert et al. 2022, phylogeny, as *Protandrena*. – Ramos et al. 2022, phylogeny, classification as *Pterosarus*. – Ascher and Pickering 2022, global checklist, as *Protandrena*.

Keys: Cockerell, 1898: 195–198 (as *Panurginus*). Swenk and Cockerell, 1907: 184–85, Nebraska species (as *Panurginus*). Cockerell, 1922: 9–10, Colorado species (as *Panurginus*). Robertson, 1922: 164–166, Illinois species (as *Pseudopanurgus*). Mitchell, 1960: 263–265, eastern USA species (as *Pseudopanurgus* (*Pseudopanurgus*, *Heterosarus*)). Timberlake, 1967: 19–22, Arizona species (as *Pseudopanurgus* (*Pterosarus*)).

Diagnosis. *Protandrena* (*Pterosarus*) are small bees (4–9 mm), which are mostly black with yellow maculations appearing on the head in males (uncommonly in females), and to varying extents the pronotal lobes and legs. The forewing has two submarginal cells (*Protandrena s.s.* have three). The first segment of the labial palpus is at least as long as the remaining segments combined (*Anthemurgus* has the first segment less than half combined length of segments 2–4). Females can be further distinguished by the combination of scopal setae distinctly branched (*Heterosarus* and *Protandrena s.s.* have simple scopal setae, at most with few minute branches) and fore coxa simple (female *Pseudopanurgus* with strong projection on fore coxa). Males can

be recognized by S6 with deep narrow midapical notch (absent or broadly V-shaped in other *Protandrena*). The gonostylus is apically reflexed in most *Pterosarus* but not in other *Protandrena s.l.* The gonostylus is not reflexed in *Pr.* (*Pt.*) *albitarsis* Cresson (1872), *Pr.* (*Pt.*) and *Pr.* (*Pt.*) *atricornis* Cresson (1878). In *Pr.* (*Pt.*) *andrenoides* the gonostylus is bent near the base. *Protandena* (*Pterosarus*) are typically less coarsely sculptured than *Pr.* (*Pseudopanurgus*) s.s. and more coarsely sculptured than *Pr.* (*Heterosarus*).

***Protandrena* (*Pterosarus*) *aestivalis* (Provancher)**

(Figure 8, Figure 9)

Panurgus aestivalis Provancher, 1882: 205, ♀♂. Lectotype ♀ ULQC: 1017. Designated by Mitchell 1960. Subsequently designated by Sheffield & Perron 2014. Type locality: Canada: Quebec: Cap-Rouge. Examined by photos.

Panurginus Nebrascensis Crawford, 1903: 335–336, ♀♂. Synonymy by Sheffield and Perron 2014. Lectotype ♂ USNM: USNM ENT 00533809. Designated by Crawford 1912. Type locality: USA; Nebraska: Lincoln, 27 Aug 1902, ex. *Solidago missouriensis*. Examined by photos.

Panurginus pecki Cockerell, 1937: 114. ♂. Holotype ♂ CNC: 4173. Type locality: Canada; Alberta: Edmonton. 29 Jul 1930. Examined by photos.

Pseudopanurgus nebrascensis timberlakei Michener, 1947: 446. ♀♂ Holotype ♀ AMNH: 324258. Preoccupied by *Pseudopanurgus timberlakei* Cockerell 1931. Type locality: USA: Mississippi: Hattiesburg, 6 Oct 1944. Examined by photos.

Pseudopanurgus (*Heterosarus*) *nebrascensis muesebecki* Replacement name for *Pseudopanurgus nebrascensis timberlakei* by Michener 1951: 1100. Synonymy by Sheffield and Perron 2014.

Taxonomy: Crawford, 1912: 368 (tax. characters as *Pa*. *nebrascensis*). – Stevens, 1950: 93 (redescription as *nebrascensis*). – Mitchell, 1960: 271–272 (tax. characters), 275–276 (redescription as *nebrascensis nebrascensis*), 276–277 (redescription as *nebrascensis muesebecki*). – Timberlake, 1967: 21 (key) – Sheffield and Perron, 2014: 11 (synonymies).

Type specimens: Provancher's (1882) description of *Panurgus aestivalis* was based on both male and female syntypes. The number of specimens was not indicated. Mitchell (1960) stated that '[t]he type' was a female specimen at ULQC. He also referenced that the original description was based on both sexes using male and female symbols in the bibliographic citation. Mitchell (1960) did not refer to the female specimen as a holotype, which would have been invalid, but 'the type', which article 74.5 of the Code indicates is an equivalent expression to lectotype prior to 2000. I consider Mitchell (1960) to have legitimately designated a female syntype at ULQC as the name-bearing type (article 74.5 of the Code). Sheffield & Perron (2014) considered this designation invalid under article 74.6 and proposed a female specimen at ULQC as the lectotype, presumably the same individual examined by Mitchell. However, since Mitchell did not wrongly assume that it was the only name-bearing type and he didn't refer to it as a holotype, article 74.6 should not apply in this case. There are no other female representatives of the type series known to us at ULQC, so we assume that Mitchell (1960) and Sheffield & Perron (2014) are referring to the same specimen in their respective designations.

Crawford (1903) described *Panurginus nebrascensis* based on 20 male and eight female syntypes. Subsequently, he referred to ‘the types’ of three related species at the USNM and provided comparative notes on a ‘male type’ for *Pa. nebrascensis.* I believe this fulfills the requirements of article 74.5 of the Code for a lectotype designation. Sheffield & Perron (2014) incorrectly referred to this specimen as the holotype. It is pinned with a paralectotype female.

Cockerell (1937) likely described *Panurginus pecki* from a single holotype male, but the text is ambiguous if there were topotypical paratype males. The type by original designation is No. 4173 in the CNC.

Michener (1947) described *Ps. nebrascensis timberlakei* from a holotype male and two male and six female paratypes. The subspecific name was preoccupied and subsequently replaced with *Ps. nebrascensis muesebecki* Michener (1951).

Cockerell (1937) described *Pa. pecki* without comparing to *Pr. aestivalis* to which the type clearly matches. He provides comparative notes on a male identified as *Pa. nebrascensis* in the same study but makes no comparison to *Pa. pecki*. The type locality, Edmonton, Alberta, for *Pa. pecki* is within the expected range for *Pr. aestivalis*. Specimens of *Pr. aestivalis* from Edmonton have been examined and found to match the type of *Pa. pecki*.

Diagnosis:

Males of *Pr.* (*Pt.*) *aestivalis* can be recognized by the combination of scape with broad yellow band anteriorly and flagellum dark (contrast all except: *Pr. nudescens*, *Pr. ornatipes*, *Pr. piercei*), finely reticulate scutum punctures anteriorly (contrast *Pr. ornatipes*, *Pr. piercei*), and posterior face of propodeum without dorsal impunctate space (contrast *Pr. nudescens*).

Females of *Pr*. (*Pt*.) *aestivalis* can be recognized by combination of their labral process shape (contrast all except: *Pr*. *albitarsis*, *Pr*. *nudescens*, *Pr*. *piercei*), scutum punctures transitioning from dense anteriorly (IS < 1 PD) to sparse posteriorly (contrast *Pr*. *albitarsis* and *Pr*. *piercei*) (IS = 1 – 4 PD), and posterior face of propodeum tesselate (contrast *Pr*. *nudescens*).

Material Examined:

CANADA – **Alberta** • 1♀; Division 11, Edmonton, Gariepy river valley; 53.4903° N, 113.6194° W; 18 Aug. 2018; Buck M. leg.; PMAE • 1♂; Division 11, Edmonton, Terwilligar Park; 51.8231° N, 113.6194° W; 28 Jul. 2018; Buck M. leg.; PMAE • 1♂; Division 11, Edmonton, Windermere Crescent; [53.4517° N, 113.6191° W]; 26 Jul. 1985; Blades D. leg.; PMAE • 1♀; Division 13, Bilby; [53.7° N, 114.1° W]; 28 Jun. 1924; Bryant O. leg.; CAS • 1♀; Division 13, Clyde, 5 km NE of Clyde; [54.181° N, 113.5757° W]; 27 Jul. 1988; Thormin T.W. leg.; PMAE • 1♀; Division 13, Clyde, 7 mi. NE of Clyde; [54.2156° N, 113.5027° W]; 28 Jul. 1988; Thormin T.W. leg.; PMAE • 1♂; same location as preceding; 19 Jul. 1988; Thormin T.W. leg.; PMAE • 1♀; Division 13, Clyde, 8 mi. NE of Clyde; [54.2393° N, 113.5027° W]; 28 Jul. 1988; Thormin T.W. leg.; PMAE • 1♀; Division 5, Drumheller; [51.4667° N, 112.7° W]; 11 Aug. 1957; Brooks A.R., Brooks J.E. leg.; CNC • 1♂; Division 6, Black Foot Hills; [53.2882° N, 110.1754° W]; 07 Aug. 1940; Brooks A.R. leg.; CNC • 1♂; Division 7, Castor; [52.2167° N, 111.9° W]; 07 Aug. 1957; Brooks A.R., Brooks J.E. leg.; CNC • 15♂♂; Division 7, Stettler; [52.3333° N, 112.6833° W]; 03 Aug. 1957; Brooks A.R., Brooks J.E. leg.; CNC • 15♂♂; Division 7, Wainwright; [52.8333° N, 110.8667° W]; 27 Jul. 1957; Brooks A.R., Brooks J.E. leg.; CNC • 1♀; Kneehill, Dry Island Buffalo Jump Provincial Park; 51.9378° N, 112.9586° W; 20 Jul. 2016; Buck M. leg.; PMAE • 1♀; Kneehill, Dry Island Buffalo Jump Provincial Park; 51.9425° N, 112.9664° W; 19

Jul. 2016; Buck M. leg.; PMAE • 1♀; same location as preceding; 20 Jul. 2016; Buck M. leg.; PMAE • 1♀; Kneehill, Tolman, Postill Farm; 51.8231° N, 113.0117° W; 18 Jul. 2016; Buck M. leg.; PMAE • 1♂; Lamont, Rouge Road 194 N of Township Road 534; 53.6058° N, 112.7547° W; 03 Aug. 2015; Buck M. leg.; PMAE • 1♀; Lamont, Rouge Road 194 N of Township Road 534; 53.6058° N, 112.7881° W; 03 Aug. 2015; Buck M. leg.; PMAE • 1♀; Lamont, Rouge Road 194 N of Township Road 535; 53.6142° N, 112.7542° W; 03 Aug. 2015; Buck M. leg.; PMAE • 1♀; Rocky View, 11 U 686595 5670577; [51.1561° N, 114.331° W]; elev. 1124 m.; 16 Aug. 2010; UCMZ • 2♀♀, 1♂; Special Area no. 2, Steveville; [50.838° N, 111.61° W]; 21 Aug. 1957; Brooks A.R., Brooks J.E. leg.; CNC • 1♀, 1♂; Starland, Rumsey Nature Area, Township Road 340; 51.8789° N, 112.6847° W; 13 Jul. 2017; Buck M. leg.; PMAE • 1♀; Sturgeon, Redwater Prairie Restoration Area, E of Township Road 205; 53.935° N, 112.9456° W; 12 Aug. 2016; Buck M. leg.; PMAE • 1♀; Sturgeon, Redwater Prairie Restoration Area, W of Township road 205; 53.9344° N, 112.9519° W; 12 Aug. 2016; Buck M. leg.; PMAE • 1♀; Calgary; [50.6014° N, 114.051° W]; elev. 1043 m.; 29 Aug. 2017; Gavin M.P. leg.; UCMZ • 4♀♀; same location as preceding; 18 Aug. 2017; Gavin M.P. leg.; UCMZ • 1♂; Longview; [50.582° N, 114.0708° W]; elev. 1155 m.; 08 Aug. 2016; Johnson S. leg.; UCMZ • 1♂; Okotoks; [50.7745° N, 113.8828° W]; elev. 1077 m.; 06 Aug. 2015; Johnson S. leg.; UCMZ – **Manitoba** • 2♂♂; Division 12, Birds Hill Provincial Park; 50.0115° N, 96.9065° W; 13 Aug. 2017; Gibbs J. leg.; ex *Solidago* sp.; WRME • 3♂♂; same location as preceding; 12 Aug. 2017; Gibbs, Nozoe leg.; WRME • 2♂♂; same location as preceding; 05 Aug. 2017; Gibbs, Nozoe leg.; ex *Solidago* sp.; WRME • 1♂; same location as preceding; 05 Aug. 2017; Gibbs, Nozoe leg.; WRME • 1♂; Division 12, Birds Hill Provincial Park; [50.0115° N, 96.9065° W]; 22 Aug. 1978; Galloway T.D. leg.; WRME • 1♀; Division 12, Birds Hill Provincial Park; 50.0147° N, 96.9153° W; 03 Aug. 2018;

Shaw A. leg.; WRME • 1♂; Division 12, Birds Hill Provincial Park; 50.0115° N, 96.9065° W; 05 Aug. 2017; Gibbs, Nozoe leg.; ex *Solidago* sp.; WRME • 1♂; Division 12, Birds Hill Provincial Park; [50.0276° N, 96.887° W]; 27 Aug. 1916; Wallis J.B. leg.; CNC • 1♀; same location as preceding; 27 Aug. 1916; Wallis J.B. leg.; CNC • 1♀; Division 15, Erickson; [50.492° N, 99.907° W]; 16 Aug. 1975; Pengelley D.H. leg.; PMAE • 1♂; Division 15, Saint Lazare; [50.45° N, 101.3° W]; 19 Aug. 1954; Brooks A.R. leg.; CNC • 1♂; same location as preceding; 15 Aug. 1954; Brooks, Wallis leg.; CNC • 1♀; Division 15, Strathclair; [50.4° N, 100.4° W]; 05 Aug. 1923; Robertson A.H. leg.; CNC • 1♀; Division 16, Binscarth; [50.6167° N, 101.2833° W]; 09 Aug. 1943; Robertson H.A. leg.; CNC • 1♂; Division 17, Dauphin; [51.15° N, 100.05° W]; 23 Aug. 1982; Galloway T.D. leg.; WRME • 1♀; Division 2, Mitchell; 49.529° N, 96.804° W; 21 Aug. 2019; Shukla-Bergen S. leg.; ex *Sonchus* sp.; WRME • 1♂; Division 3, Morden; [49.18° N, 98.1° W]; 19 Aug. 1985; WRME • 1♂; Division 7, 2 mi. E of Douglas; [49.8927° N, 99.7282° W]; 27 Jul. 1958; Chillcott J.G. leg.; CNC • 1♀; Division 7, Aweme; [49.7093° N, 99.6119° W]; 13 Aug. 1925; Bird B.D. leg.; CNC • 1♂; same location as preceding; 11 Aug. 1924; Criddle N. leg.; CNC • 5♂♂; Division 7, Carberry; [49.8667° N, 99.35° W]; 11 Aug. 1953; Brooks, Kelton leg.; CNC • 2♀♀; Division 7, Yellow Quill Prairie Preserve; 49.6808° N, 99.5566° W; 08 Aug. 2005; Patenaude A.M. leg.; WRME • 1♂; Virden (19.6 km WSW); [49.8014° N, 101.1961° W]; 13 Aug. 2021; Abel O. leg.; CMN – **New Brunswick** • 1♂; Kings, Nerepis; [45.4018° N, 66.2841° W]; Leavitt A.G. leg.; SEMC • 1♂; Saint John, Saint John; [45.2308° N, 66.0953° W]; 06 Aug. 1900; Leavitt A.G. leg.; CNC • 1♂; same location as preceding; 10 Aug. 1902; Leavitt A.G. leg.; CNC • 1♂; same location as preceding; 09 Aug. 1903; Leavitt A.G. leg.; CNC – **Nova Scotia** • 1♀; Kings, Avonport; 45.1198° N, 64.273° W; 20 Sep. 2001; Sheffield C. leg.; RSKM • 1♀; Kings, Kingsport;

[45.1179° N, 64.3555° W]; 28 Aug. 1958; Kessel E.L. leg.; CAS – **Ontario** • 2♀♀; Norfolk, Manester Tract, 6 km NNW of St. Williams; [42.7167° N, 80.4465° W]; 24 Aug. 2001; Buck M. leg.; PMAE • 1♂; Norfolk, Manester Tract, 6 km NNW of St. Williams; 42.7047° N, 80.4606° W; 25 Aug. 2005; Paiero S. leg.; ex *Solidago* sp.; PMAE • 1♂; Norfolk, Normandale; [42.7107° N, 80.3112° W]; 04 Sep. 1954; Miller C.D. leg.; CNC • 1♂; Northumberland, Barr prop., 7 km NE of Centreton; 44.1289° N, 77.9833° W; 26 Aug. 2011; Paiero S. leg.; PMAE • 1♀; Peterborough, Norwood; [44.3824° N, 77.9799° W]; 24 Aug. 1982; Galloway T.D. leg.; WRME • 1♀; Thunder Bay, Thunder Bay, Hogarth; 48.2119° N, 89.2338° W; 06 Aug. 2019; Fredenburg A. leg.; ex *Solidago juncea*; WRME • 2♀♀; Thunder Bay, Thunder Bay, Lakehead University Hanger; 48.2509° N, 89.16° W; 27 Aug. 2019; Fredenburg A. leg.; ex *Eurybia macrophylla*; WRME • 2♀♀; same location as preceding; 27 Aug. 2019; Fredenburg A. leg.; ex *Solidago juncea*; WRME • 3♀♀; same location as preceding; 21 Aug. 2019; Fredenburg A. leg.; ex *Eurybia macrophylla*; WRME • 1♀; same location as preceding; 21 Aug. 2019; Fredenburg A. leg.; ex *Solidago canadensis*; WRME • 3♀♀; same location as preceding; 12 Aug. 2019; Fredenburg A. leg.; ex *Solidago canadensis*; WRME • 1♀; same location as preceding; 15 Aug. 2019; Fredenburg A. leg.; ex *Solidago juncea*; WRME • 1♂; same location as preceding; 15 Aug. 2019; Fredenburg A. leg.; ex *Eurybia macrophylla*; WRME • 5♀♀; Toronto, Toronto; [43.6532° N, 79.3832° W]; 01 Sep. 1993; CNC • 2♀♀; York, Toronto; [43.6667° N, 79.4167° W]; 1993; PMAE • 1♀; Ottawa, Bruce Pit Dog Park; [45.3258° N, 75.7983° W]; 05 Sep. 2021; Onuferko T.M. leg.; ex *Solidago* sp.; TOPC • 1♀; same location as preceding; 06 Sep. 2021; Onuferko T.M. leg.; ex *Solidago* sp.; TOPC • 1♀; same location as preceding; 12 Sep. 2021; Onuferko T.M. leg.; ex *Solidago* sp.; TOPC • 1♂; same location as preceding; 20 Sep. 2021; Onuferko T.M. leg.; ex Euthamia graminifolia; TOPC • 1♂; same location as preceding; 18 Sep.

2021; Onuferko T.M. leg.; ex Euthamia graminifolia; TOPC • 1♂; same location as preceding; 24 Sep. 2021; Onuferko T.M. leg.; ex Euthamia graminifolia; TOPC • 2♀♀; Ottawa, Conroy Pit Dog Park; [45.3577° N, 75.6291° W]; 03 Sep. 2021; Onuferko T.M. leg.; ex *Solidago* sp.; TOPC – **Quebec** • 1♀; Quebec City, Quebec City, Cap Rouge; [46.7526° N, 71.3397° W]; 24 Feb. 1905; Provancher leg.; ULQ – **Saskatchewan** • 1♀, 1♂; Division 1, Estevan; [49.15° N, 103° W]; 15 Aug. 1955; Brooks A.R. leg.; CNC • 2♀♀, 2♂♂; same location as preceding; 16 Aug. 1955; Miller C.D. leg.; CNC • 1♂; same location as preceding; 15 Aug. 1955; Miller C.D. leg.; CNC • 1♂; Division 1, Kelso; [49.9704° N, 101.9513° W]; 14 Aug. 1925; King K.M. leg.; CNC • 3♀♀, 1♂; Division 1, Kennedy; [50.0167° N, 102.35° W]; 10 Aug. 1925; King K.M. leg.; CNC • 1♀; Division 11, Saskatoon; [52.1333° N, 106.6667° W]; 06 Aug.; Kingo K. leg.; UCMC • 1♀; Division 13, Rutland; [52.5157° N, 109.5287° W]; 02 Aug. 1940; Brooks A.R. leg.; CNC • 1♀; Division 14, Whitefox; [53.4528° N, 104.0887° W]; 22 Aug. 1959; Brooks A.R., Brooks J.E. leg.; CNC • 1♂; Division 15, Christopher Lake; [53.54° N, 105.7892° W]; 11 Aug. 1959; Brooks A.R., Brooks J.E. leg.; CNC • 1♂; Division 15, Dana ; [52.2892° N, 105.7053° W]; 25 Jul. 1959; Brooks A.R. leg.; CNC • 6♂♂; Division 15, Prince Albert; [53.2° N, 105.75° W]; 23 Jul. 1959; Brooks A.R., Brooks J.E. leg.; CNC • 3♀♀, 2♂♂; same location as preceding; 02 Sep. 1954; Brooks A.R., Wallis J.B. leg.; CNC • 1♀; Division 15, St. Louis; [52.9167° N, 105.8° W]; 02 Sep. 1924; Atkinson N.J. leg.; CNC • 3♀♀; Division 16, Holbein ; [53.2341° N, 106.2161° W]; 03 Sep. 1954; Brooks, Wallis leg.; CNC • 1♀; Division 17, Meadow Lake; [54.1297° N, 108.4347° W]; 28 Aug. 1977; Murrell D.C. leg.; PMAE • 1♀; Division 2, Torquay; [49.1333° N, 103.4833° W]; 14 Aug. 1955; Miller C.D. leg.; CNC • 2♂♂; Division 3 , Rockglen; [49.1833° N, 105.95° W]; 02 Aug. 1955; Brooks A.R. leg.; CNC • 1♂; same location as preceding; 03 Aug. 1955; Miller C.D. leg.; CNC • 3♀♀, 5♂♂; Division 5, Broadview; [50.3833° N, 102.5667° W];

10 Aug. 1925; King K.M. leg.; CNC • 1♂; same location as preceding; 12 Aug. 1954; Brooks A.R., Wallis J.B. leg.; CNC • 1♂; same location as preceding; 10 Aug. 1925; King K.M. leg.; CNC • 1♂; Division 5, Stockholm; [50.6608° N, 102.3016° W]; 13 Aug. 1954; Brooks, Wallis leg.; CNC • 1♂; Division 6, Holdfast; [50.963° N, 105.405° W]; 07 Aug. 1925; King K.M. leg.; CNC • 1♂; Division 6, Indian Head ; [50.5333° N, 103.6667° W]; 10 Aug. 1954; Brooks, Wallis leg.; CNC • 1♂; same location as preceding; 08 Aug. 1924; deGryse J.J. leg.; CNC • 1♂; Division 6, Lumsden; [50.65° N, 104.8667° W]; 04 Aug. 1954; Brooks, Wallis leg.; CNC • 1♂; same location as preceding; 07 Aug. 1954; Brooks, Wallis leg.; CNC • 1♂; Division 6, Rowan's Ravine Provincial Park; 50.9907° N, 105.1734° W; 01 Aug. 2018; DeMeyer C. leg.; RSKM • 1♂; same location as preceding; 01 Aug. 2018; Oram R. leg.; RSKM • 14♀♀; Division 6, White City; 50.4339° N, 104.3657° W; elev. 611 m.; 21 Aug. 2012; Sheffield C. and K. leg.; ex Asteraceae sp.; RSKM • 2♀♀; same location as preceding; 30 Aug. 2012; Poulin R. Sheffield C. and K. leg.; RSKM • 1♀; Division 8, Gull Lake; [50.1° N, 108.4833° W]; 23 Aug. 1931; Manson G.F. leg.; CNC • 3♂♂; Division 9, Canora; [51.6333° N, 102.4333° W]; 22 Aug. 1954; Brooks, Wallis leg.; CNC • 1♀; Dick Lake; 04 Sep. 1954; Brooks, Wallis leg.; CNC • 2♀♀; Prince Albert National Park; [53.7301° N, 106.7224° W]; elev. 518 m.; 16 Aug. 2010; Biobus leg.; BIO • 1♀; same location as preceding; 15 Aug. 2010; Biobus leg.; BIO **USA** – **Colorado** • 1♀; Douglas, 1 mi. NE of Greenland; 39.1884° N, 104.8438° W; elev. 2164 m.; 29 Aug. 1999; Hicks A.L., Scott V. leg.; UCMC • 1♀; Elbert, Running Creek Field Station; 39.2344° N, 104.6206° W; elev. 2118 m.; 14 Sep. 1980; Boyden leg.; UCMC • 1♀; same location as preceding; 14 Sep. 1980; Brown F.M. leg.; UCMC • 1♀; Elbert, Running Creek Field Station; 39.2348° N, 104.6295° W; elev. 2118 m.; 10 Sep. 1979; Brown F.M. leg.; ex *Erigeron*; UCMC – **Connecticut** • 2♂♂; Hartford, East Hartford; [41.7823° N, 72.612° W]; 18 Aug. 1947; CUIC •

1♀, 1♂; Tolland, Stafford; [41.9848° N, 72.289° W]; 24 Aug. 1905; Britton W.E. leg.; CAES • 1♀; Canaan (3 mi S); [42° N, 73.2° W]; 29 Aug. 1966; Fullerton S.M. leg.; UCMS – **Georgia** • 1♂; Decateur, Spring Creek; [30.802° N, 84.7873° W]; 23 Sep. 1953; Fattig P.W. leg.; UGCA – **Illinois** • 1♀; Kanakee, Hopper Br.; [41° N, 87.55° W]; 12 Sep. 2003; Jean R.P. leg.; ex *Ionactus linariifolia*; RJPC • 1♂; Macoupin, Carlinville; 39.2797° N, 89.8817° W; 31 Aug. 1971; Marlin J.C. leg.; ex *Helianthus grosseserratus*; INHS • 2♂♂; Washington, DuBois; 38.2517° N, 89.2114° W; 09 Aug. 1917; INHS • 2♂♂; INHS – **Indiana** • 1♀; Jasper, Stoutsburg; [41.1734° N, 87.0939° W]; 12 Sep. 2003; Jean R.P. leg.; ex *Symphyotrichum oolentangiense*; RJPC • 1♀; same location as preceding; 02 Sep. 2018; Jean R.P. leg.; ex *Solidago* sp.; RJPC – **Kansas** • 1♀; Grant, Hyannis; [42.0005° N, 101.7618° W]; 03 Sep. 1969; Michener C.D. leg.; SEMC • 1♂; Reno, Hutchinson; [38.0608° N, 97.9298° W]; 02 Sep. 1951; Michener, LaBerge leg.; ex *Boltonia asteroides*; SEMC – **Maryland** • 1♀; Anne Arundel; [38.8879° N, 76.6653° W]; 24 Sep. 2017; McMahon leg.; BIML – **Michigan** • 1♂; Cheboygan; [45.5472° N, 84.5636° W]; 13 Jun. 1942; Zukauskas A. leg.; SEMC • 2♀♀; same location as preceding; Kennedy C.H. leg.; OSUC • 2♀♀; Midland , Chippewa Nature Center; 43.6065° N, 84.2857° W; 06 Sep. 2018; ex *Solidago* sp.; WRME • 1♀; Oscoda, Huron-Manistee S.F., Markle Prairie; [44.602° N, 84.3665° W]; 16 Aug. 2021; USFS leg.; UMNHC • 1♀, 3♂♂; Van Buren, 4 km SE Covert; 42.263° N, 86.229° W; 28 Aug. 2014; Gibbs J. leg.; ex *Solidago* sp.; WRME • 1♀; Van Buren, Paw Paw Prairie Fen Nature Preserve; 42.172° N, 85.768° W; 27 Aug. 2018; Wood T.J. leg.; WRME – **Michigan** • 1♂; Barry , Pierce Creek Cedar Institute; [42.536° N, 85.3° W]; 25 Aug. 2017; Wood T.J. leg.; WRME • 1♂; Dickinson , Foster City; [45.996° N, 87.825° W]; 12 Aug. 2018; Wood T.J. leg.; WRME • 1♀; Gratiot, Wheeler; [43.466° N, 84.419° W]; 30 Aug. 2018; Wood T.J. leg.; WRME • 1♀, 1♂; Tuscola, Mayville; [43.401° N, 83.413° W]; 30 Aug. 2017; Wood

T.J. leg.; WRME • 1♂; Van Buren, Paw Paw Prairie Fen Nature Preserve ; [42.172° N, 85.768° W]; 27 Aug. 2018; Wood T.J. leg.; WRME – **Minnesota** • 1♂; Beltrami, Lake Bemidji State Park; [47.5352° N, 94.8268° W]; 22 Jul. 1968; LaBerge W.E. leg.; INHS • 2♂♂; Clay, Felton Prairie; [47.1015° N, 96.4076° W]; 20 Aug. 2005; Turnbow R. leg.; UGCA • 1♀; Otter Tail, Fergus Falls; [46.283° N, 96.0776° W]; 25 Aug. 1911; Stower leg.; UMSP • 2♀♀; Polk, Crookston; [47.7741° N, 96.6081° W]; 02 Sep. 1935; Denning D.G. leg.; UMSP • 1♂; Polk; [47.7598° N, 96.6278° W]; 15 Aug. 1924; Carter W. leg.; UMSP • 1♂; Pope, Glacial Lakes State Park; [45.5412° N, 95.5335° W]; 15 Aug. 1973; UMSP • 1♂; Rock, Luverne; [43.6541° N, 96.2128° W]; 10 Sep. 1912; UMSP • 2♂♂; Saint Louis, Eagle's Nest; 47.84° N, 92.0962° W; 30 Jul. 1958; Balduf W.V. leg.; INHS • 1♀; Sherburne, Freemont WMA; 45.4292° N, 93.61° W; 06 Sep. 2018; Gedlinske L. leg.; MNDNR • 1♀; Traverse; [45.8032° N, 96.8352° W]; 14 Sep. 1938; Mickel C.E. leg.; UMSP • 1♂; Yellow Medicine; [44.7376° N, 96.4664° W]; 15 Sep. 1938; Milliron H.E. leg.; UMSP – **Nebraska** • 1♂; York, McCool; [40.7442° N, 97.5975° W]; 28 Aug. 1940; Milliron H.E. leg.; UMSP – **New Hampshire** • 3♂♂; Belknap, Meredith; [43.6575° N, 71.5003° W]; 03 Aug. 1957; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 4♂♂; same location as preceding; 07 Aug. 1960; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 3♂♂; same location as preceding; 22 Aug. 1960; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 5♂♂; same location as preceding; 23 Aug. 1960; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 1♂; same location as preceding; 24 Aug. 1960; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 4♂♂; same location as preceding; 26 Aug. 1960; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 1♂; same location as preceding; 30 Aug. 1960; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 2♂♂; same location as preceding; 18 Aug. 1962; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 2♂♂; same location as preceding; 26 Aug. 1962; Morse R.A., Morse J.G. leg.; ex *Solidago* sp.; CUIC •

3♂♂; same location as preceding; 27 Aug. 1962; Morse R.A., Morse J.G. leg.; ex *Solidago* sp.; CUIC • 1♂; same location as preceding; 31 Aug. 1962; Morse R.A., Morse J.G. leg.; ex *Solidago* sp.; CUIC • 1♂; same location as preceding; 14 Aug. 1966; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 3♀♀; same location as preceding; 31 Aug. 1960; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 1♀; same location as preceding; 27 Aug. 1962; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 1♂; same location as preceding; 26 Aug. 1962; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 1♂; same location as preceding; 07 Aug. 1960; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 1♂; same location as preceding; 27 Aug. 1960; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 1♂; same location as preceding; 31 Aug. 1962; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 1♀; Belknap; [43.5034° N, 71.4074° W]; 24 Aug. 1960; Morse R.A. leg.; ex *Eurybia macrophylla*; CUIC • 2♂♂; Grafton; [43.9088° N, 71.826° W]; 20 Jul. 1963; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 1♂; Grafton; [43.9662° N, 72.4013° W]; 20 Aug. 1963; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 1♂; Sullivan; [43.377° N, 72.2364° W]; 22 Jul. 1963; Morse R.A. leg.; ex *Solidago* sp.; CUIC – **New Jersey** • 1♀; Bergen, Closter; [40.9732° N, 73.9615° W]; 21 Sep. 1965; Rozen J.G. leg.; AMNH • 2♀♀; same location as preceding; 17 Sep. 1972; Rozen J.G. leg.; AMNH – **New York** • 1♀; Dutchess, Pawling, Dutcher Avenue; 41.562° N, 73.6026° W; 04 Sep. 2017; Gambino P. leg.; WRME • 1♂; Sullivan, Roscoe (3 mi E); [41.9259° N, 74.8647° W]; 03 Aug. 1997; Ascher J.S. leg.; ex *Solidago* sp.; CUIC • 2♀♀; Warren, Lake George; [43.4262° N, 73.7123° W]; 1894-08-17; Zabriskie J.L. leg.; AMNH – **North Dakota** • 1♂; Barnes, Valley City; [46.9233° N, 98.0032° W]; 13 Aug. 1912; Stevens O.A. leg.; ex *Chrysopsis* sp.; AMNH • 1♂; Benson, Pleasant Lake; [48.3614° N, 99.8021° W]; 11 Aug. 1913; Stevens O.A. leg.; AMNH • 1♀; Cass, Fargo; [46.8772° N, 96.7898° W]; 28 Sep. 1913; Stevens O.A. leg.; ex *Taraxacum officinale*; AMNH • 1♀; same location as preceding; 17 Aug. 1911; Stevens O.A. leg.; AMNH • 1♂; same

location as preceding; 16 Aug. 1917; Stevens O.A. leg.; ex *Grindelia squarrosa*; AMNH • 1♂; Emmons, Hazelton; [44.9566° N, 93.9516° W]; 18 Aug. 1982; Dimatteo J. leg.; UMSP • 1♂; Golden Valley, Beach; [46.9181° N, 104.0044° W]; 18 Aug. 1921; Ainslie C.N. leg.; UMSP • 1♂; Grand Forks, Grand Forks; [47.9253° N, 97.0329° W]; 19 Aug. 1917; Fattig P.W. leg.; CUIC • 1♀; Griggs, Karnak (2.5 km SE); 47.2697° N, 98.0353° W; 11 Aug. 2011; Evans E. leg.; MNDNR • 1♀; same location as preceding; 14 Aug. 2012; Evans E. leg.; MNDNR • 1♀; LaMoure, Edgeley; [46.3591° N, 98.7157° W]; 27 Aug. 1921; Stevens O.A. leg.; ex *Grindelia squarrosa*; AMNH • 1♂; McHenry, Granville; [48.2678° N, 100.8426° W]; 07 Aug. 1915; Stevens O.A. leg.; ex *Grindelia squarrosa*; AMNH • 1♀; Morton, Breien; [46.38° N, 100.9424° W]; 21 Aug. 1922; Stevens O.A. leg.; ex *Erigeron annuus*; AMNH • 1♀; Nelson, Lakota; [48.0428° N, 98.3362° W]; 03 Sep. 1913; Stevens O.A. leg.; ex *Grindelia squarrosa*; AMNH • 1♂; Ramsey, Crary; [48.0708° N, 98.6384° W]; 23 Aug. 1917; Stevens O.A. leg.; ex *Grindelia squarrosa*; AMNH • 1♂; same location as preceding; 23 Aug. 1913; Stevens O.A. leg.; ex *Grindelia squarrosa*; CUIC • 2♀♀; Ramsey, Devils Lake; [48.1122° N, 98.876° W]; 20 Aug. 1913; Stevens O.A. leg.; ex *Grindelia squarrosa*; AMNH • 1♀; Ransom, Sheldon (7 mi SE); [46.514° N, 97.386° W]; 19 Aug. 1972; Powers J.R. leg.; ex *Grindelia squarrosa*; UCMS • 4♂♂; Renville, Tolley; [48.7289° N, 101.8274° W]; 06 Aug. 1915; Stevens O.A. leg.; ex *Grindelia squarrosa*; AMNH • 3♂♂; Stutsman, Edmunds (2.4 km E); 47.2523° N, 98.933° W; 10 Aug. 2011; Evans E. leg.; MNDNR • 1♀; Stutsman, Jamestown; [46.9105° N, 98.7084° W]; 16 Aug. 1913; Stevens O.A. leg.; AMNH • 1♀; Stutsman, Pingree (11.2 km N); 47.2482° N, 98.9329° W; 15 Aug. 2010; Evans E. leg.; MNDNR • 1♂; Stutsman, Pingree (12.4 km NW); 47.2005° N, 98.8062° W; 15 Aug. 2010; Evans E. leg.; MNDNR • 1♀; Williams, Williams; [48.432° N, 103.2924° W]; 24 Aug. 1969; Michener C.D. leg.; ex *Verbesina* sp.; SEMC • 2♂♂;

Williams, Williston; [48.147° N, 103.618° W]; 06 Aug. 1915; Stevens O.A. leg.; ex *Grindelia squarrosa*; AMNH – **South Carolina** • 1♂; Aiken, Aiken, Savannah River Nuclear Plant; [33.348° N, 81.7389° W]; 22 Sep. 1954; Cross W.H. leg.; UGCA – **Tennessee** • 1♂; Carroll, Milan VTS; [35.9114° N, 88.6455° W]; 09 Sep. 2019; RJPC – **Texas** • 1♀; Bastrop, Sayersville; [30.2317° N, 97.3269° W]; 07 Oct. 1985; Neff J.L. leg.; ex *Heterotheca latifolia*; CTMI • 1♂; Smith, Swan; 32.442° N, 95.361° W; 03 Oct. 2018; Neff J.L. leg.; ex *Heterotheca subaxillaris*; CTMI – **Vermont** • 1♂; Bennington; [43.0279° N, 73.135° W]; 22 Jul. 1963; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 1♂; Windsor, North Branch Black River; 43.3741° N, 72.4992° W; 20 Aug. 2020; Hardy S. leg.; UVM • 1♂; Windsor, Sharon; 43.7905° N, 72.4894° W; 29 Jul. 2020; Hardy S. leg.; UVM – **Wisconsin** • 1♀; Eau Clair, Eau Clair; 44.8688° N, 91.4567° W; 07 Jul. 2007; Wolf M. leg.; RMNH • 1♀; Marinette, Dunbar Barrens South; [45.6713° N, 88.2549° W]; 16 Aug. 2020; Schutt N. leg.; ex *Symphyotrichum oolentangiense*; RMNH • 1♂; Oconto, Lakewood, Chequamegon-Nicolet National Forest; 45.1658° N, 88.3161° W; elev. 283 m.; 28 Aug. 2019; USFS Staff leg.; RMNH

Male:

Structure: Body length 5–6.33 mm. Head broader than long (HL/HW ratio 0.85). Face below antennae convex. Labral process trapezoidal, broader than long, apex truncate. Clypeus with median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.29). Posterior ocelli 0.27 mm apart. Flagellomeres broader than long. Dorsal pronotal carina extends laterally to pronotal lobes. Prosternum not produced. ITD 1.06 mm. Metapostnotum not extended medially. Tarsi 2–4 triangular. Fore tarsi width 0.13 mm. S6 notch deep, extending approximately 1/2 of disk, lateral carina absent.

Sculpture: Clypeus punctation fine and dense (IS < 1 PD). Paraocular punctation coarse and dense (IS = 0.5 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 1 MOD from dorsal tangent of antennal socket. Frons finely reticulate. Vertex coarsely reticulate. Mesoscutum punctation finely reticulate anteriorly, sparser posteriorly (IS < 1 PD). Scutellum punctation coarse and dense (IS < 1 PD) reticulate medially. Mesopleuron punctation coarse and dense (IS < 1 PD). Lateral propodeum coarsely reticulate. Posterior propodeum rugose. Posterior propodeum tessellate. Dorsal face of T1 punctation fine and dense (IS < 1 PD). T2 basal impression strong, basal 1/2 of T2 lineolate. T3 punctation dense (IS < 1 PD). T4 punctation absent.

Colour: Clypeus yellow. Supraclypeal area yellow to within 1 MOD of antennal socket. Lower paraocular area yellow to within 1 puncture distance of antennal socket medially, and extending narrowly along margin of compound eye to dorsal tangent of antennal socket. Labral process yellow. Mandible yellow. Scape yellow anteriorly. Flagellomeres dark. Pronotal lobe yellow. Tegula brown. Wing veins and stigma dark, membrane smoky. Fore tibia yellow anteriorly dark posteriorly, mid tibia yellow basally and apically dark medially, hind tibia broadly yellow basally and narrowly yellow apically. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, yellow. Scutellum pilosity medium-length, yellow. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium length, dense. S4 pubescence medium length, dense, with medially directed apicolateral fringes. S5 pubescence long, medially directed apicolateral fringes.

Female:

Structure: Body length range 5.4–7.3 mm. Head broader than long (HL/HW ratio 0.85). Face below antennae convex. Labral process anchor shaped, broader than long, apex rounded. Clypeus without median impressed line. Compound eyes convergent below (UOD/LOD ratio 1.11). Posterior ocelli 0.29 mm apart. Flagellomeres broader than long. Dorsal pronotal carina extends laterally to pronotal lobes. Prosternum not produced. ITD 1.35 mm. Metapostnotum strongly extended medially >50% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.07 mm.

Sculpture: Clypeus punctation fine and sparse (IS = 1). Paraocular punctation fine and dense medially (IS < 1 PD) sparser and coarser laterally (IS > 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea clavate. Foveae converging above, narrow end terminating in line with dorsal tangent of antennal socket. Frons finely reticulate. Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation denser anteriorly (IS < 1 PD) sparser posteriorly (IS = 1 – 4 PD). Scutellum punctation fine and sparse (IS > 1 PD) denser medially (IS < 1 PD). Mesopleuron punctation fine and sparse (IS > 1 PD). Lateral propodeum finely reticulate. Posterior propodeum punctation fine and dense (IS < 1 PD). Posterior propodeum tessellate. Dorsal face of T1 punctation fine and sparse (IS > 1 PD). T2 basal impression shallow, basal 1/3 of T2 lineolate. T3 punctation dense (IS < 1 PD). T4 punctation absent.

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F3-F10 yellow ventrally. Pronotal lobe black. Tegula light brown. Wing veins and stigma dark, membrane smoky. Fore and mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, yellow. Scutellum pilosity of two forms long and medium-length, white. Mesopleuron pilosity long, white. Sternite pubescence colour yellow. S3

pubescence medium length, sparse. S4 pubescence medium length, sparse. S5 pubescence long, medially directed apicolateral fringes.

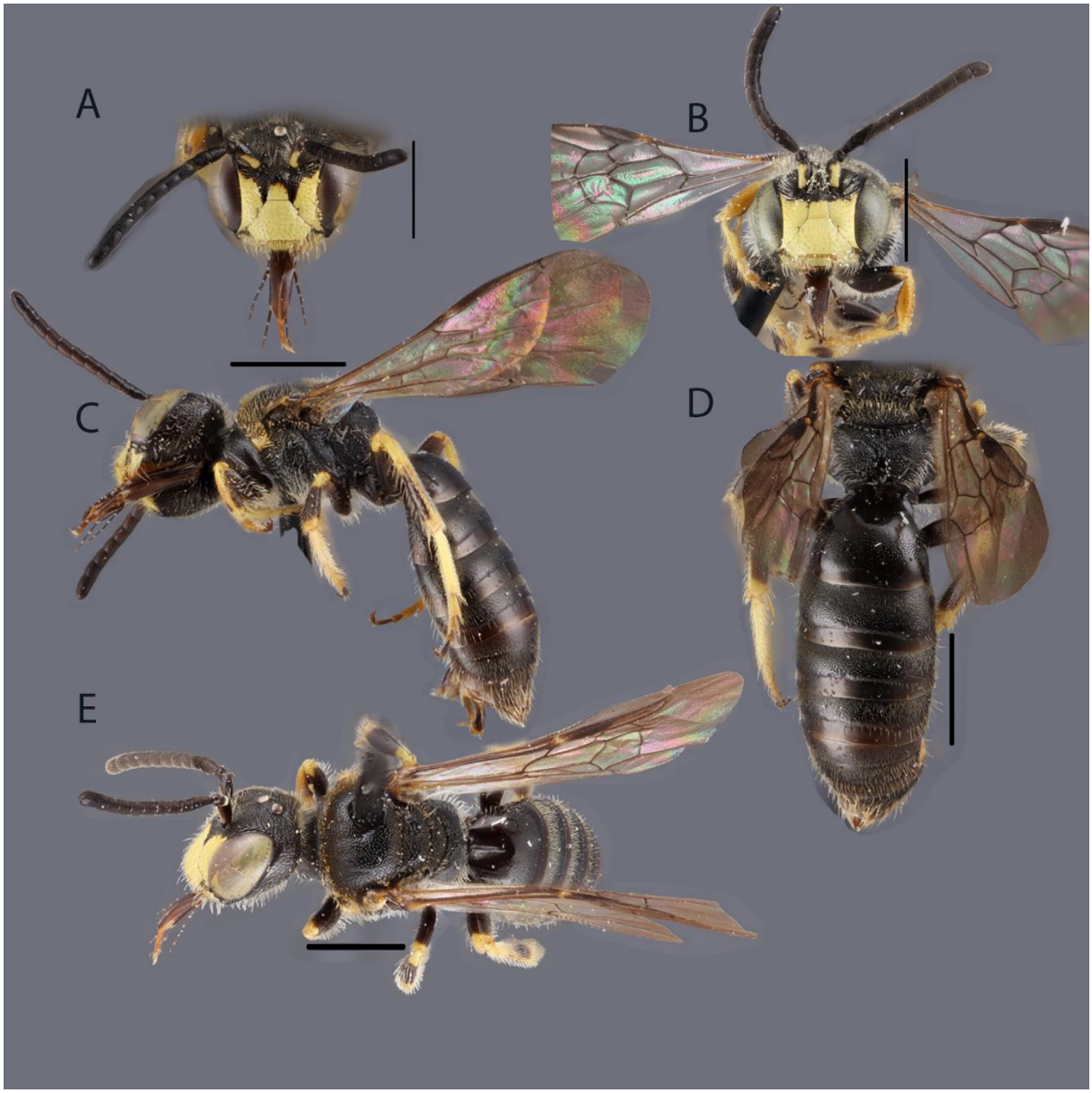


Figure 8. *Protandrena* (*Pterosarus*) *aestivalis*, ♂. WRME_362892 face light, WRME_379473 face dark. **A**. Face dark. **B.** Face light. **C.** Lateral habitus. **D.** Metasoma. **E.** Dorsal habitus. Scale bars: 1 mm.

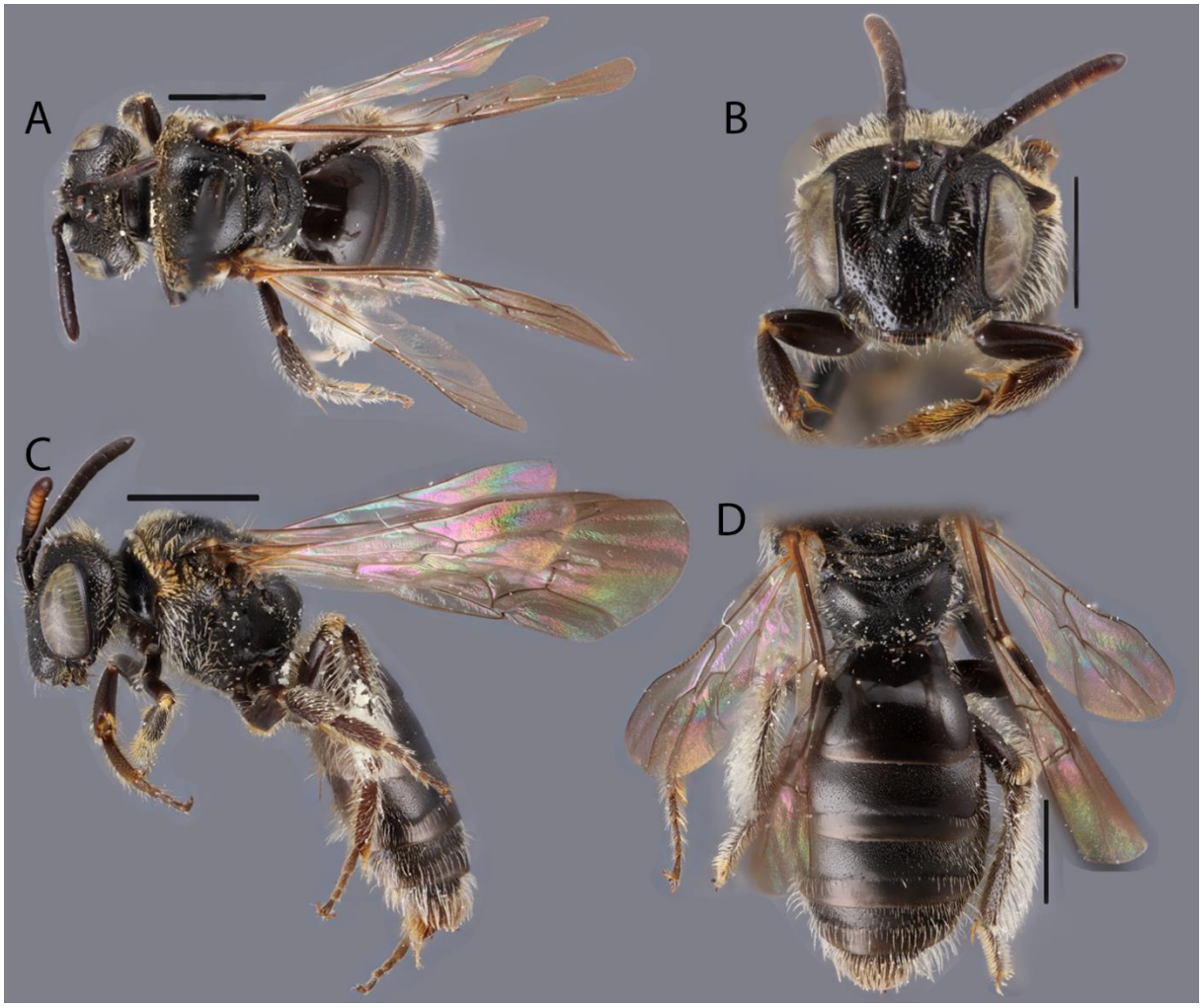


Figure 9. *Protandrena* (*Pterosarus*) *aestivalis*, ♀. RSKM_115429. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena aestivalis* is active from late June to early October in parts of its range. The "light" form (Figure 8A) can be recognized by the broad yellow of the face, forming an almost straight line under the antennae. The "dark" form (Figure 8B) is mostly yellow in the face but has two narrow dark triangles that reach the clypeus medially. Most floral records come from the composite tribe Astereae (Table 1), with only four specimens examined collected from other tribes. Literature records (Stevens 1950) also indicate collections from three additional

families. It seems evident this is a specialist on Asteraceace with distinct preference for the tribe Astereae, especially goldenrods and late-season asters.

Range: Canada (Nova Scotia west to Alberta), USA (Maine South to Florida and West to Colorado).

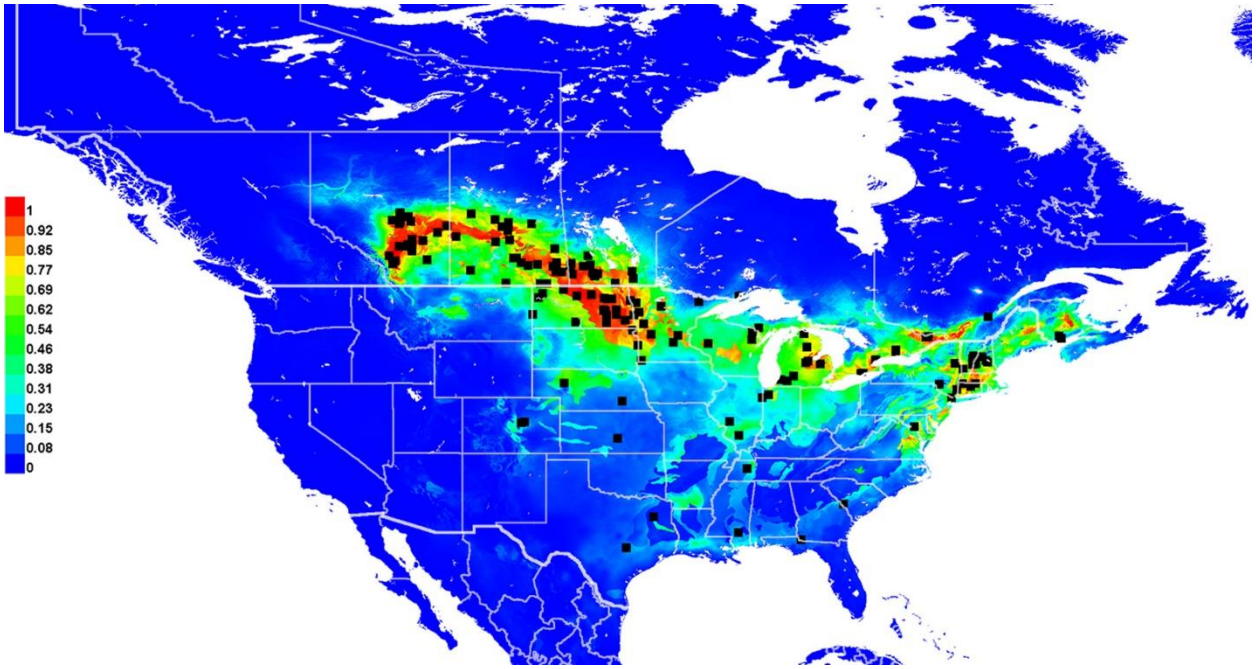


Figure 10. Georeferenced collection records of *Protandrena* (*Pterosarus*) *aestivalis* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *albertensis* (Cockerell)**

(Figure 11, Figure 12)

Panurginus piercei albertensis Cockerell, 1937: 33. ♀. Holotype CNC: 4175. Type locality: Canada; Alberta: Edmonton. 21 Aug 1930. Examined by photos.

Taxonomy: Gibbs et al. 2023: 11 (treatment as *Protandrena* (*Pterosarus*) *albertensis*)

Type specimens:

The holotype female of *Panurginus piercei albertensis* is at the CNC. There is no indication in the original description of other specimens in the type series. The type specimen for *Panurginus piercei albertensis* exhibits clear separation from *Pr. piercei* and related species by lacking the conically produced prosternum that is diagnostic of the group. As such it has been elevated from a subspecies of *Pr. piercei* to a distinct species.

Diagnosis:

Males of *Pr.* (*Pt.*) *albertensis* can be recognized by a combination of their inflated tarsi (contrast all except: *Pr. atricornis*, *Pr. boylei*, *Pr. citrinifrons*, *Pr. occultata Pr. piercei*, *Pr. rowellae*, and *Pr. skeggox*), scape yellow anteriorly (contrast *Pr. atricornis*, *Pr. boylei*, *Pr. citrinifrons*, *Pr. occultata*, which have dark brown scapes), and scutum punctures that are dense anteriorly (IS < 1 PD) and sparser posteriorly (IS > 1 PD) (contrast *Pr. piercei*, *Pr. rowellae*, *Pr. skeggox*, which are uniformly spaced).

Females of *Pr.* (*Pt.*) *albertensis* can be recognized by their semicircular labral process (contrast all except *Pr. citrinifrons*) and their non-macrosculptured posterior face of propodeum (contrast *Pr. citrinifrons*).

Material examined:

CANADA – **Alberta** • 1♀; Division 11, 6 km W of Edmonton, Wagner Natural Area; [53.5702° N, 113.8295° W]; 13 Aug. 1985; Spanton, Finnamore, Thormin leg.; PMAE • 1♀; Division 11, Edmonton; [53.55° N, 113.5° W]; 11 Aug. 1916; Carr F.S. leg.; CNC • 1♂; Division 11, Edmonton; [53.5554° N, 113.7728° W]; 13 Jul. 1989; Segall C., Wittick J., Sparrow-Clarke P.

leg.; PMAE • 2♂♂; same location as preceding; 08 Jul. 1988; Segall C., Brower E., Reaney L. leg.; PMAE • 1♂; same location as preceding; 11 Jul. 1984; Finnamore A.T. leg.; PMAE • 1♀; Division 11, Edmonton; [53.55° N, 113.5° W]; 22 Aug. 1963; Scudder G.G.E. leg.; CNC • 1♂; Division 17, High Prairie; [55.4333° N, 116.4833° W]; 25 Jul. 1961; Brooks A.R. leg.; CNC • 1♀; Division 17, Peace River District, Whitemud River; [56.5249° N, 118.0000° W]; 22 Aug. 1932; Russell L.S. leg.; CNC • 1♂; Division 18, Valleyview; [55.0667° N, 117.2833° W]; 10 May. 1961; Brooks A.R. leg.; CN • 1♀; Division 6, Morley (15 mi. East); [51.2057° N, 114.5121° W]; 19 Jul. 1962; Hermann K.C. leg.; CNC • 2♀♀, 1♂; Division 7, Wainwright; [52.8333° N, 110.8667° W]; 27 Jul. 1957; Brooks A.R., Brooks J.E. leg.; CNC • 1♀; Foothills; [50.6172° N, 114.3686° W]; elev. 1355 **m**.; 26 Aug. 2010; Evans M. leg.; UCMZ • 1♀; Lamont, Rouge Road 194 N of Township Road 534; 53.6044° N, 112.7791° W; 03 Aug. 2015; Buck M. leg.; PMAE • 1♂; Lethbridge, Lethbridge; [49.6884° N, 112.9856° W]; 20 Aug. 1981; McCorquodale D.B. leg.; PMAE • 1♀; Rocky View; [51.1561° N, 114.331° W]; elev. 1124 **m**.; 16 Aug. 2010; Evans M. leg.; UCMZ • 1♀; Aldersyde; [50.7364° N, 113.6982° W]; elev. 1079 **m**.; 22 Aug. 2016; Johnson S. leg.; UCMZ • 1♂; Aldersyde; [50.7761° N, 113.7898° W]; elev. 1040 **m**.; 28 Jul. 2016; Johnson S. leg.; UCMZ • 1♂; Arrowood (near); [50.7638° N, 113.1901° W]; elev. 907 **m**.; 29 Jul. 2016; Johnson S. leg.; UCMZ • 1♀; Blackie; [50.6303° N, 113.6598° W]; elev. 1025 **m**.; 18 Aug. 2016; Johnson S. leg.; UCMZ • 1♀; Blackie; [50.6906° N, 113.6101° W]; elev. 1068 **m**.; 17 Jul. 2016; Gavin M. leg.; UCMZ • 1♂; Blackie; [50.6303° N, 113.6598° W]; elev. 1025 **m**.; 21 Jul. 2015; Johnson S. leg.; UCMZ • 3♀♀; Calgary; [50.6014° N, 114.051° W]; elev. 1043 **m**.; 18 Aug. 2017; Gavin M.P. leg.; UCMZ • 1♀; Claresholm; [50.1109° N, 113.4251° W]; elev. 969 **m**.; 25 Jul. 2017; Gavin M. leg.; UCMZ • 1♂; De Winton; [50.7729° N, 114.1633° W]; elev. 1256 **m**.; 08 Aug. 2016; Johnson S. leg.; UCMZ • 1♂; same

location as preceding; 29 Jul. 2016; Johnson S. leg.; UCMZ • 1♀; Edmonton; [53.55° N, 113.5° W]; 21 Aug. 1930; Peck O. leg.; CNC • 1♀; Gladys (5.5 km from); [50.6887° N, 113.7825° W]; elev. 1059 **m**.; 22 Aug. 2016; Johnson S. leg.; UCMZ • 1♂; Gladys (5.6 km from); [50.6887° N, 113.7825° W]; elev. 1059 **m**.; 14 Jul. 2015; Johnson S. leg.; UCMZ • 1♂; Hartell (0.2 km from); [50.601° N, 114.2356° W]; elev. 1128 **m**.; 08 Aug. 2016; Johnson S. leg.; UCMZ • 1♂; Herronton (4.4 km from); [50.6013° N, 113.4902° W]; elev. 1013 **m**.; 13 Jul. 2015; Johnson S. leg.; UCMZ • 1♂; Herronton (6.3 km from); [50.5722° N, 113.4028° W]; elev. 999 **m**.; 29 Jul. 2016; Johnson S. leg.; UCMZ • 1♀; Mazeppa; [50.6014° N, 113.7052° W]; elev. 1007 **m**.; 22 Aug. 2016; Johnson S. leg.; UCMZ • 1♂; Mazeppa (3.4 km from); [50.6574° N, 113.6982° W]; elev. 1030 **m**.; 03 Jul. 2015; Johnson S. leg.; UCMZ • 1♀; Mossleigh; [50.776° N, 113.6364° W]; elev. 1041 **m**.; 18 Aug. 2016; Johnson S. leg.; UCMZ • 1♀; Mossleigh; [50.762° N, 113.2828° W]; elev. 936 **m**.; 09 Aug. 2016; Johnson S. leg.; UCMZ • 1♂; Mossleigh; [50.776° N, 113.6364° W]; elev. 1041 **m**.; 21 Jul. 2015; Johnson S. leg.; UCMZ • 1♂; Mossleigh (10.5 km from); [50.6304° N, 113.2782° W]; elev. 1113 **m**.; 27 Jul. 2015; Johnson S. leg.; UCMZ • 1♀; Orkney District; 22 Aug. 1930; Manson G.F. leg.; CNC – **Manitoba** • 1♂; Division 14, Oak Hammock Marsh; 50.142° N, 97.184° W; 12 Jul. 2019; Hanuschuk E. leg.; WRME • 1♀; same location as preceding; 12 Jul. 2019; Hanuschuk E. leg.; WRME • 1♀; Division 15, Erickson; [50.492° N, 99.907° W]; 09 Aug. 1984; Pengelley D.H. leg.; WRME • 1♂; Division 16, Angusville; [50.7349° N, 101.0199° W]; 20 Jul. 1954; Brooks, Wallis leg.; CNC • 1♂; Division 16, Russell; [50.7833° N, 101.2833° W]; 16 Aug. 1954; Brooks, Wallis leg.; CNC • 3♀♀; Division 18, Saint Laurent (7 km NNE); 50.474° N, 97.923° W; 25 Jul. 2020; Martini M. leg.; WRME • 3♀♀; same location as preceding; 25 Jul. 2020; Shukla-Bergen S. leg.; WRME • 1♀; Division 7, Aweme; 49.716° N, 99.644° W; 22 Aug. 2018; Hanuschuk E. leg.; WRME • 1♀;

Division 9, Delta; [50.1833° N, 98.3167° W]; 25 Aug. 1974; Galloway T.D. leg.; WRME • 7♀♀; Division 9, High Bluff, (2 mi. W); [50.0197° N, 98.1935° W]; 04 Aug. 1967; Webb D.W. leg.; ex *Sonchus arvensis*; INHS • 1♀; Division 9, High Bluff, 3 mi. E of Portage La Prairie; [49.9753° N, 98.3631° W]; 03 Aug. 1967; Webb D.W. leg.; ex *Sonchus arvensis*; INHS • 1♀; Division 9, High Bluff, 3 mi. S of St. Vital; [49.7828° N, 97.1092° W]; 26 Jul. 1967; Webb D.W. leg.; ex *Sonchus arvensis*; INHS • 1♀; Division 9, High Bluff, 5 mi. N of Portage La Prairie; [50.0462° N, 98.2855° W]; 03 Aug. 1967; Webb D.W. leg.; ex *Sonchus arvensis*; INHS • 3♂♂; Methley Beach; [51.2016° N, 99.5671° W]; 13 Jul. 1989; Lowen R.G. leg.; CNC • 1♀; Stormy Mountain; 28 Aug. 1924; Hunter A.J. leg.; CNC – **Saskatchewan** • 1♀; Division 14, Hudson Bay; [52.85° N, 102.3833° W]; 06 Sep. 1959; Brooks A.R., Brooks J.E. leg.; CNC • 1♀; same location as preceding; 06 Sep. 1959; Brooks A.R., Brooks J.E. leg.; CNC • 1♂; Division 15, Christopher Lake; [53.54° N, 105.7892° W]; 11 Aug. 1959; Brooks A.R., Brooks J.E. leg.; CNC • 2♀♀; Division 15, Dana ; [52.2892° N, 105.7053° W]; 25 Jul. 1959; Brooks A.R. leg.; CNC • 1♀; Division 15, Rosthern; [52.65° N, 106.3333° W]; 17 Aug. 1914; Sladen F.W.L. leg.; CNC • 2♀♀; Division 3 , Rockglen; [49.1833° N, 105.95° W]; 02 Aug. 1955; Brooks A.R. leg.; CNC • 1♂; Division 6, Katepwa Beach; [50.6959° N, 103.6246° W]; 11 Aug. 1954; Brooks, Wallis leg.; CNC **USA** – **Minnesota** • 1♂; Roseau; [48.7687° N, 96.3081° W]; 16 Aug. 1924; Carter W. leg.; UMSP

Description:

Male: Structure: Body length range 5.98–6.95 mm. Head broader than long (HL/HW ratio 0.88). Face below antennae convex. Labral process trapezoidal, broader than long, apex truncate. Clypeus with median impressed line. Compound eyes convergent below (UOD/LOD ratio 1.19).

Posterior ocelli 0.33 mm apart. Flagellomeres broader than long. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.19 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 inflated. Fore tarsi width 0.257 mm. S6 notch deep, extending approximately 1/2 of disk, lateral carina absent.

Sculpture: Clypeus punctation fine and dense (IS < 1 PD). Paraocular punctation fine and dense (IS < 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea ovate. Foveae converging above, posterior end terminating 0.5 MOD from dorsal tangent of antennal socket. Frons punctation fine and dense (IS < 1 PD). Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation fine and dense anteriorly (IS < 1 PD) sparser posteriorly (IS > 1 PD). Scutellum punctation coarse and dense laterally (IS < 1 PD) reticulate medially. Mesopleuron punctation coarse and sparse posteriorly (IS = 1 PD) coarsely reticulate anteriorly. Lateral propodeum coarsely reticulate. Posterior propodeum rugose. Posterior propodeum tessellate. Dorsal face of T1 punctation very fine and dense laterally (IS < 1 PD) impunctate medially. T2 basal impression deep, basal 1/3 of T2 lineolate. T3 punctation dense (IS < 1 PD). T4 punctation sparse (IS = 1 PD).

Colour: Clypeus yellow. Supraclypeal area yellow terminating in line with ventral tangent of antennal socket. Lower paraocular area yellow extending up to ventral tangent of antennal socket medially and extending narrowly along compound eye terminating in a fine point in line with dorsal tangent of antennal socket. Labral process yellow. Mandible yellow. Scape yellow anteriorly. Flagellomeres F3-F11 yellow ventrally. Pronotal lobe yellow. Tegula yellow. Wing veins and stigma dark, membrane smoky. Fore and mid tibae yellow anteriorly dark posteriorly, hind tibia promarily yellow with reduced dark posterior spot. Tarsi yellow.

Pubescence: Mesoscutum pilosity medium-length, white. Scutellum pilosity long, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium length, dense. S4 pubescence medium length, dense. S5 pubescence long, medially directed apicolateral fringes.

Female: Structure: Body length range 6.56–7.63 mm. Head broader than long (HL/HW ratio 0.86). Face below antennae convex. Labral process semicircular, longer than broad, apex rounded. Clypeus with median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.05). Posterior ocelli 0.33 mm apart. Flagellomeres broader than long. Dorsal pronotal carina present laterally but not medially. Prosternum not produced. ITD 1.39 mm. Metapostnotum weakly extended medially <25% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.075 mm.

Sculpture: Clypeus punctation coarse and sparse (IS = 1 – 2 PD). Paraocular punctation fine and sparse (IS > 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea clavate. Foveae converging above, narrow end terminating in line with ventral tangent of antennal socket. Frons punctation fine and dense (IS < 1 PD). Vertex punctation coarse and sparse (IS = 1 PD). Mesoscutum punctation fine and sparse anteriorly (IS = 1 PD) sparser posteriorly (IS > 2 PD). Scutellum punctation fine and sparse laterally (IS > 1 PD) denser medially (IS < 1 PD). Mesopleuron punctation fine and sparse posteriorly (IS > 1 PD) coarsely reticulate anteriorly. Lateral propodeum finely reticulate. Posterior propodeum punctation absent. Posterior propodeum tessellate. Dorsal face of T1 punctation very fine and sparse (IS > 3 PD). T2 basal impression shallow, basal 1/3 of T2 lineolate. T3 punctation sparse (IS = 1 PD). T4 punctation sparse (IS > 1 PD).

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F3-F9 yellow ventrally. Pronotal lobe black. Tegula light brown. Wing veins and stigma brown, membrane hyaline. Fore tibia with yellow spot at knee, remaining tibia entirely black. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity medium-length, yellow. Mesopleuron pilosity long, white. Sternite pubescence colour yellow. S3 pubescence medium length, sparse. S4 pubescence medium length, sparse. S5 pubescence long, medially directed apicolateral fringes.

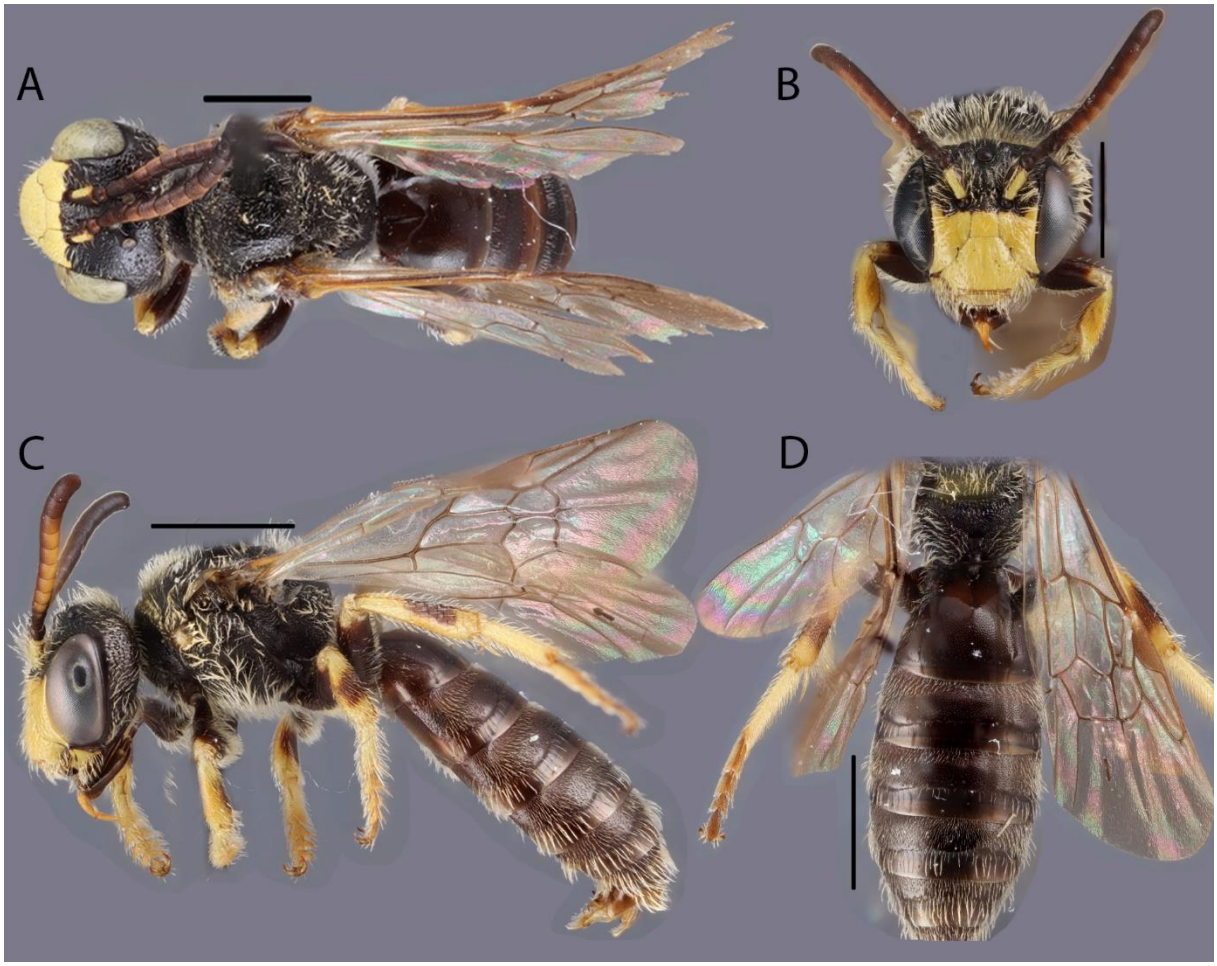


Figure 11. *Protandrena* (*Pterosarus*) *albertensis*, ♂. CNC. A. Dorsal habitus. B. Face. C. Lateral habitus. D. Metasoma. Scale bars: 1 mm.

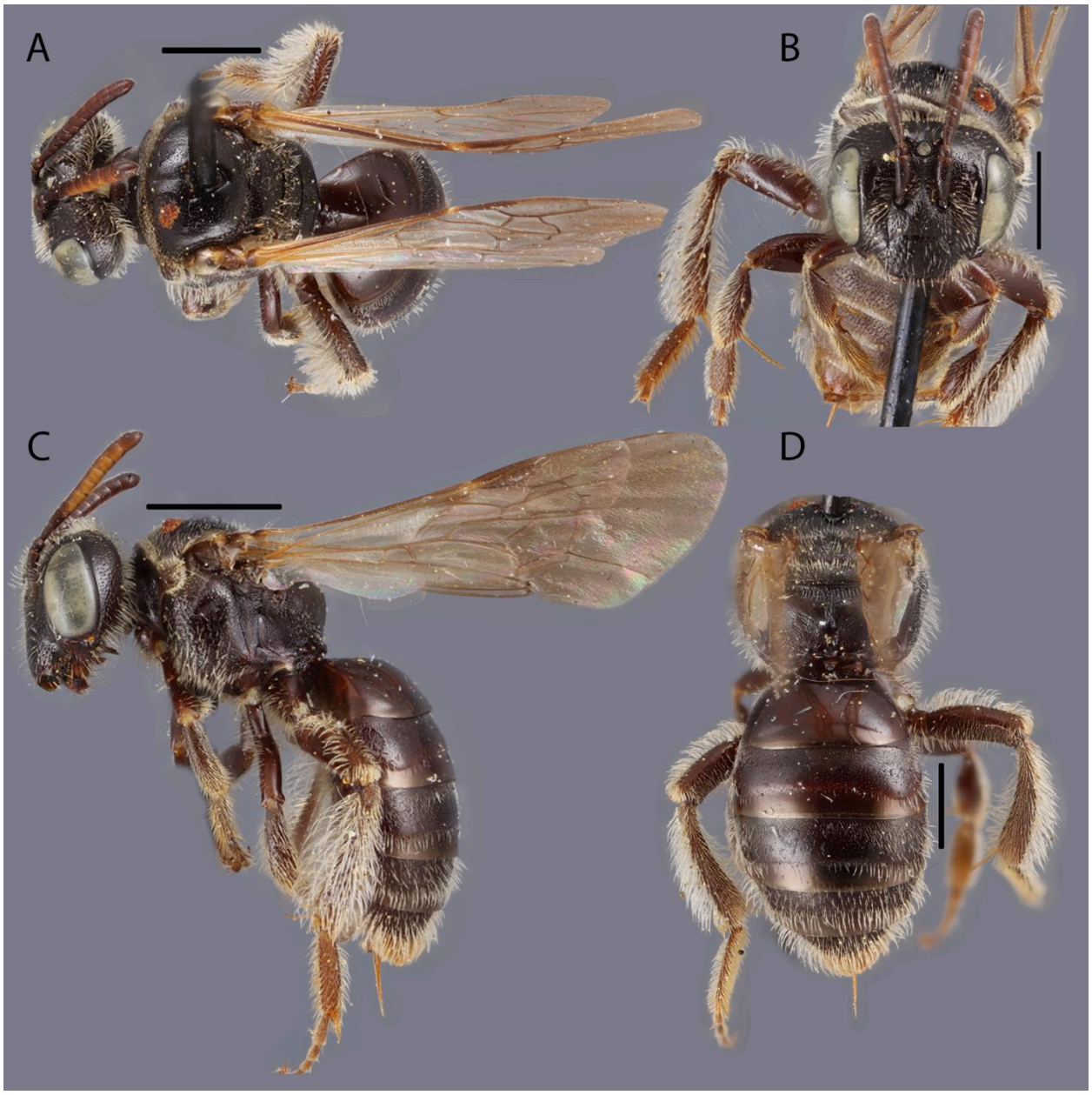


Figure 12. *Protandrena* (*Pterosarus*) *albertensis*, ♀. CNC. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes:

Protandrena albertensis is active from July to September. All floral records have been from the tribe Chichorieae however only 6 specimens have associated floral records (3 males 3 females).

Range: Canada (Alberta, Manitoba, Saskatchewan). USA (Minnesota).

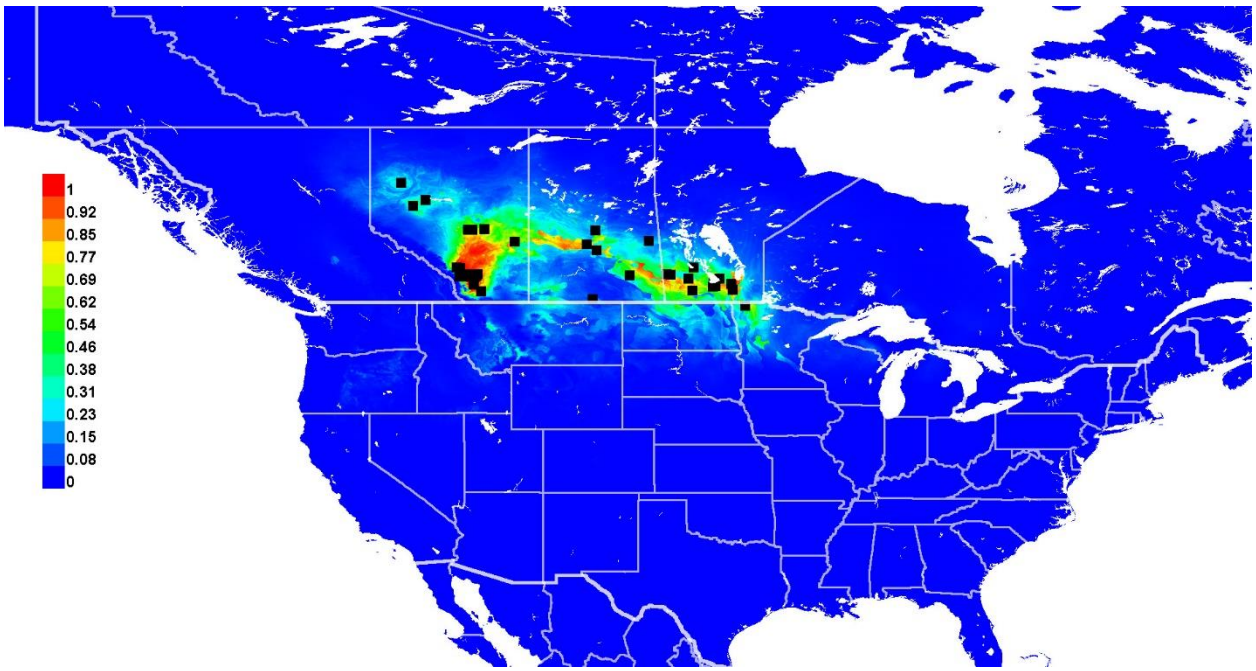


Figure 13. Georeferenced collection records of *Protandrena* (*Pterosarus*) *albertensis* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *albipes* new species**

(Figure 14, Figure 15)

Holotype: ♂ USA – Arizona • Yavapai, Mayer; [34.3978° N, 112.2363° W]; 31 Aug. 2006; Rozen J.G. leg.; AMNH. AMNH_IZC00292082

Diagnosis:

Males of *Pr*. (*Pt*.) *albipes* can be recognized by a combination of their small size (< 5 mm) (contrast all except: *Pr. labrosiformis*, *Pr. vicinus*, *Pr. vigvierae*), full yellow face (contrast *Pr. labrosiformis*, *Pr. vicinus*) and yellow scape (contrast *Pr. vigvierae*).

Females of *Pr*. (*Pt*.) *albipes* can be recognized by a combination of their yellow pronotal lobes (contrast all except: *Pr. alveus*, *Pr. amor*, *Pr. barberi*, *Pr. labrosus*, *Pr. occidua*, *Pr. ornatipes*, *Pr. quadrapylae*, *Pr. ehnesae*, *Pr. ximenesiae*), finely reticulate posterior face of propodeum (contrast *Pr. alveus, Pr. amor*, *Pr. barberi*, *Pr. labrosus*, *Pr. ornatipes*) fine and dense scutum punctures (contrast *Pr. quadrapylae*, *Pr. ximenesiae*), and fine and dense mesopleuron punctation (contrast *Pr. occidua*).

Material Examined

USA – **Arizona** • 1♀; Yavapai, Dewey; [34.53° N, 112.2413° W]; 01 Sep. 2006; Rozen J.G., Rozen K.C. leg.; AMNH

• 2♂♂; Yavapai, Mayer; [34.3978° N, 112.2363° W]; 31 Aug. 2006; Rozen J.G. leg.; AMNH

Description

Male:

Structure: Body length range 4.73–5.17 mm. Head broader than long (HL/HW ratio 0.83). Face below antennae convex. Labral process trapezoidal, broader than long, apex emarginate. Clypeus without median impressed line. Compound eyes convergent below (UOD/LOD ratio 1.2). Posterior ocelli 0.28 mm apart. Flagellomeres longer than broad. Dorsal pronotal carina absent. Prosternum not produced. ITD 0.93 mm. Metapostnotum extended medially 25%–50% way to

propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.11 mm. S6 notch shallow, less than 1/3 of disk, lateral carina absent.

Sculpture: Clypeus punctation fine and dense (IS < 1 PD). Paraocular punctation fine and dense (IS < 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 0.5 MOD from dorsal tangent of antennal socket. Frons finely reticulate. Vertex finely reticulate. Mesoscutum punctation fine and dense (IS < 1 PD). Scutellum punctation fine and dense (IS < 1 PD). Mesopleuron punctation fine and dense (IS < 1 PD). Lateral propodeum finely reticulate. Posterior propodeum finely reticulate. Posterior propodeum tessellate. Dorsal face of T1 punctation fine and dense (IS < 1 PD). T2 basal impression deep, approximately 1/2 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation sparse (IS = 1 PD).

Colour: Clypeus yellow. Supraclypeal area yellow to within 0.5 MOD of antennal socket. Lower paraocular area yellow reaching ventral tangent of antennal socket medially extending along margin of compound eyes terminating in line with dorsal tangent of antennal socket. Labral process yellow. Mandible yellow. Scape yellow anteriorly. Flagellomeres F1-F8 yellow ventrally. Pronotal lobe black. Tegula brown. Wing veins and stigma brown, membrane hyaline. All tibia yellow anteriorly, dark posteriorly. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity medium-length, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium-length, sparse. S4 pubescence medium-length, sparse. S5 pubescence medium-length, sparse.

Female:

Structure: Body length 5.8 mm. Head broader than long (HL/HW ratio 0.85). Face below antennae convex. Labral process trapezoidal, broader than long, apex rounded. Clypeus without median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.06). Posterior ocelli 0.26 mm apart. Flagellomeres broader than long. Dorsal pronotal carina extends laterally to pronotal lobes. Prosternum not produced. ITD 1.14 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.0625 mm.

Sculpture: Clypeus punctation fine and sparse (IS = 1 PD). Paraocular punctation fine and sparse (IS = 1 PD). Supraclypeal area punctation fine and sparse (IS = 1 PD). Fovea clavate. Foveae converging above, narrow end terminating in line with dorsal tangent of antennal socket. Frons punctation fine and dense (IS < 1 PD). Vertex punctation fine and dense (IS < 1 PD). Mesoscutum punctation fine and dense (IS < 1 PD). Scutellum punctation fine and dense (IS < 1 PD). Mesopleuron punctation fine and dense (IS < 1 PD). Lateral propodeum finely reticulate. Posterior propodeum finely reticulate. Posterior propodeum tessellate. Dorsal face of T1 punctation fine and sparse (IS > 5 PD). T2 basal impression shallow, approximately 1/3 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F4-F10 yellow ventrally. Pronotal lobe yellow. Tegula brown. Wing veins and stigma brown, membrane brown. Fore and mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, yellow. Scutellum pilosity medium-length, yellow. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium-length, sparse. S4 pubescence medium-length, sparse. S5 pubescence medium-length, sparse.

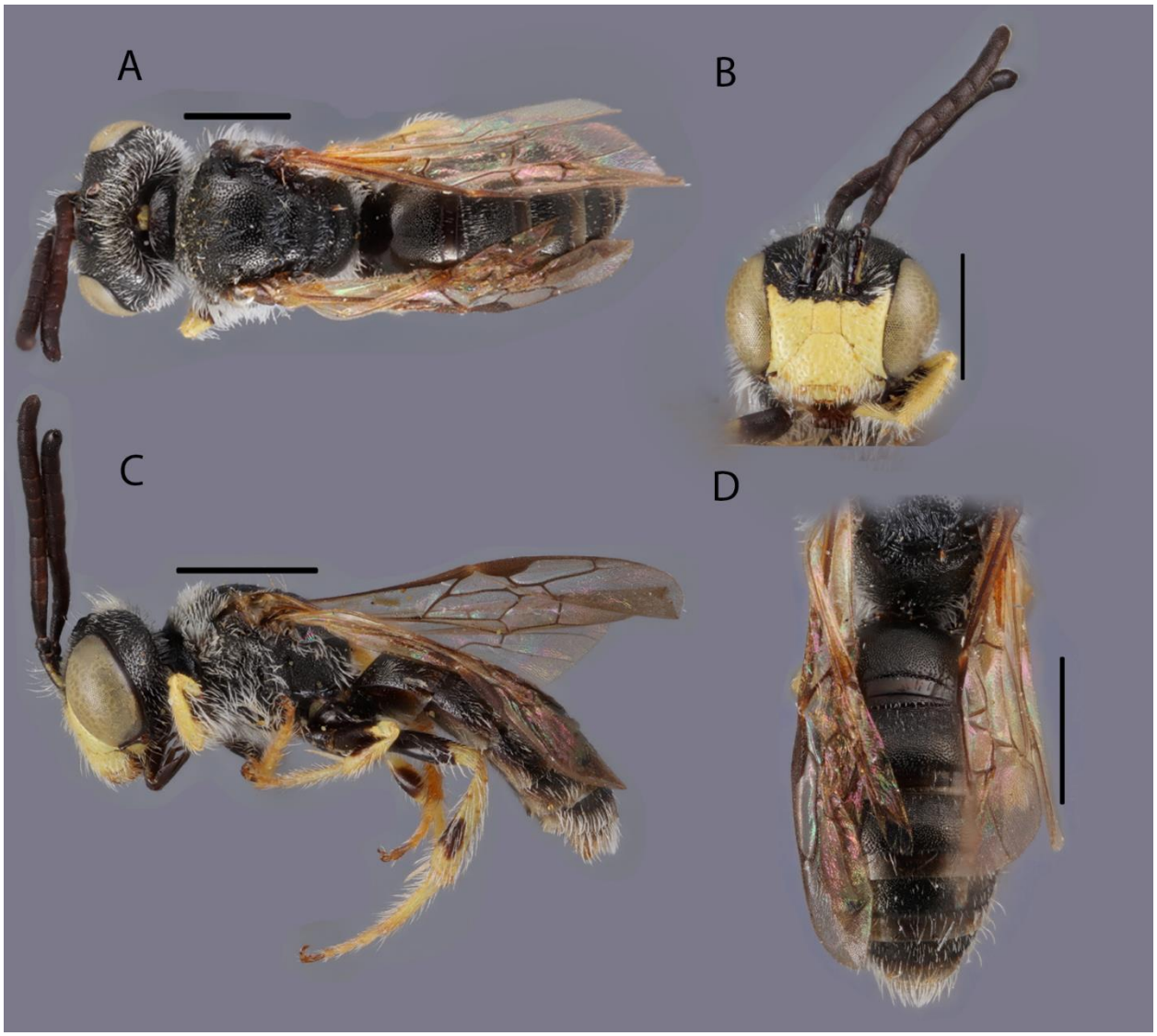


Figure 14. *Protandrena* (*Pterosarus*) *albipes*, ♂. AMNH_00292078. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.



Figure 15. *Protandrena* (*Pterosarus*) *albipes*, ♀. AMNH_292088. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. Scale bars: 1 mm.

***Protandrena* (*Pterosarus*) *albitarsis* (Cresson)**

(Figure 16, Figure 17)

Panurgus albitarsis Cresson, 1872: 260, ♀♂ Lectotype ♀ ANSP: 2202 designation by Cresson 1916. Type locality: USA; Texas: Bosque County. Examined specimen.

Panurgus picipes Cresson, 1872: 261, ♂ Lectotype ♀ ANSP: 2204 Lectotype designation by Cresson 1916. Synonymy by Mitchell 1960. Type locality: USA; Texas: Bosque County. Examined by photos.

Calliopsis innuptus Cockerell, 1896c: 222. "♀" = ♂. Holotype ♂ NMNH: Type locality: USA; Colorado: Colorado Springs. Jul 1895. **New synonymy.** Examined by photos.

Panurginus albitarsis fortior Cockerell, 1899: 129. ♂. Syntype ♂ NMNH: 533805. Type locality: USA; New Mexico: Mescalero. 22 Jul 1898. Synonymy with *innuptus* by Muesebeck et al. 1951. Examined by photos.

Panurginus porterae Cockerell, 1900: 364. ♂. Syntype ♂. CAS: 15419. Type locality: USA; New Mexico: Beulah. 25 Aug 1899. **New synonymy.** Examined by photos.

Panurginus innuptus var. *absonus* Cockerell, 1912: 446. ♂. Syntype ♂. CAS Type locality: USA; New Mexico: Pecos. Aug 1912. Synonymy with *innuptus* by Muesebeck et al. 1951. Not examined.

Taxonomy: Cockerell, 1898: 194; ♂♀ redescription as *innuptus*. – Cockerell, 1899b: 266; taxonomy as *innuptus* – Cockerell, 1900: 364, ♂ comparative notes. – Robertson, 1922: 165–166, redescription. **–** Stevens, 1950: 92; ♂ redescription as *innuptus*)). – Michener 1951: xxx, catalogue. – Mitchell, 1960: 266–267 Synonymy, ♀♂ redescription. – Timberlake, 1967: 20–22; ♀♂ redescription).

Type specimens: Cresson (1872) described *Panurgus albitarsis* based on four syntypes, including males and females. Cresson (1916) selected a female specimen at the ANSP as the lectotype. Cresson (1872) described *Panurgus picipes* based on two male syntypes. Cresson (1916) selected one specimen at the ANSP as the lectotype. Cockerell (1896) described the male of *Calliopsis innuptus* from a single male specimen, which is the holotype. Cockerell (1899) described *Panurginus albitarsis fortior* from male specimens. The number of specimens was not

indicated, and a holotype was not selected. Cockerell (1900) described *Panurginus porterae* from both the male and female. The number of specimens was not indicated. No holotype was designated. Cockerell (1912) provided a terse description of *Panurginus innuptus* var. *absonus* from an unknown number of males. He commented that he expected it to be synonymous with *Pa. picipes*. In his initial description of *Calliopsis innuptus* Cockerell (1896) described a specimen which he mistakenly identified as a female. However, when comparing the type of *Calliopsis innuptus* with specimens of *Panurginus albitarsis* Cockerell remarked that it resembles the male more so than the female. Examination of specimens from across the range of both species shows that there is no considerable geographical separation, the mild colouration differences of tarsi between the types is variable, and that floral host preference is consistent.

Diagnosis.

Males of *Pr*. (*Pt*.) *albitarsis* can be recognized by a combination of their dark labral process (contrast all except *Pr*. *bidentis* and *Pr*. *californica*) trapezoidal labral process (contrast *Pr*. *bidentis*) and yellow on paraocular region of face (contrast *Pr*. *californica*).

Females of *Pr*. (*Pt*.) *albitarsis* can be recognized by a combination of their labral process shape (contrast all except: *Pr*. *aestivalis*, *Pr*. *nudescens* and *Pr*. *piercei*) uniformly spaced scutum punctures (contrast *Pr*. *aestivalis*, *Pr*. *nudescens*) and non-produced prosternum (contrast *Pr*. *piercei*).

Material examined

CANADA – **Alberta** • 1♀; Cypress, Onefour, Granny Hunter Coulee; 49.0833° N, 110.5256° W; 17 Aug. 2014; Buck M. leg.; PMAE • 1♀; Cypress, Onefour, Onefour (6 km SW); 49.0661°

N, 110.5056° W; 16 Aug. 2014; Buck, Cobb leg.; PMAE • 1♀; Division 1, Canadian Forces Base Suffield, Suffield Wildlife Management Area; 50.3911° N, 110.6128° W; 31 Jul. 1995; Pollock, Finnamore leg.; PMAE • 1♀; Division 1, Elkwater Park; [49.6584° N, 110.2955° W]; 15 Aug. 1962; Konotopetz L.A. leg.; CNC • 1♂; Division 1, Medicine Hat; [50.0333° N, 110.6833° W]; 20 Aug. 1916; Sladen F.W.L. leg.; CNC • 1♂; same location as preceding; 17 Jul. 1917; Sladen F.W.L. leg.; CNC • 1♀; same location as preceding; 20 Aug. 1916; Sladen F.W.L. leg.; CNC • 1♂; Division 1, Medicine Hat, Burnside; 50.0497° N, 110.7628° W; 27 Jun. 2017; Pittel H. leg.; ex *Helianthus*; PMAE • 1♂; Division 1, Redcliff, Redcliff (1.5 km SE); 50.0514° N, 110.7672° W; 27 Jun. 2017; Buck M. leg.; ex *Helianthus*; PMAE • 5♀♀, 11♂♂; Division 2, Lethbridge; [49.7° N, 112.8333° W]; 28 Jul. 1916; Sladen F.W.L. leg.; CNC • 1♀, 1♂; same location as preceding; 27 Jul. 1916; Sladen F.W.L. leg.; CNC • 1♂; Division 2, Warner, North Bridge Highway 4a; [49.2854° N, 112.1997° W]; 29 Jul. 1981; McCorquodale D.B. leg.; PMAE • 1♀; Division 2, Writing-on-stone National Park, Grass-South; [49.0859° N, 111.6217° W]; 13 Aug. 1990; McCorquodale D.B. leg.; PMAE • 1♀; Division 2, Writing-on-stone National Park, Sand Pit; [49.0859° N, 111.6217° W]; 08 Jul. 1981; McCorquodale D.B. leg.; PMAE • 1♀; Division 8, Dunmore; [49.9667° N, 110.5833° W]; CNC • 1♀; Kneehill, Tolman, Postill Farm; 51.8231° N, 113.0117° W; 18 Jul. 2016; Buck M. leg.; PMAE • 1♂; Taber; [49.8447° N, 111.7197° W]; elev. 809 m.; 23 Aug. 2011; Zink L. leg.; UCMZ • 1♂; Cranford; [49.815° N, 112.2562° W]; elev. 767 m.; 01 Jul. 2015; Robinson S. leg.; UCMZ • 1♀; Mossleigh (13.6 km from); [50.8053° N, 113.4635° W]; elev. 960 m.; 27 Jul. 2015; Johnson S. leg.; UCMZ – **Manitoba** • 1♀; Division 1, Tall Grass Prarie Preserve; 49.075° N, 96.718° W; 06 Aug. 2009; Semmier S. leg.; WRME • 1♀; Division 2, Randolph; 49.546° N, 96.844° W; 19 Jul. 2019; Shukla-Bergen S. leg.; WRME • 1♂; Division 2, Ridgeville; 49.119° N, 97.011° W; 22 Aug.

2019; Shukla-Bergen S. leg.; WRME • 4♀♀, 1♂; Division 3, Altona; [49.1° N, 97.5667° W]; 10 Aug. 1951; Askew W.L. leg.; ex *Helianthus* sp.; CNC • 1♀, 1♂; Division 5, Lyleton; [49.05° N, 101.1667° W]; 27 Jul. 1939; Peterson L. leg.; UMSP • 1♂; Division 5, Melita; [49.2667° N, 100.9833° W]; 25 Jul. 1958; Brooks A.R., Brooks J.E. leg.; CNC • 1♂; Division 7, Aweme; [49.7093° N, 99.6119° W]; 15 Aug. 1916; Criddle N. leg.; CNC – **Saskatchewan** • 1♀; Division 1, Estevan; 49.134° N, 102.9967° W; 04 Jul. 2018; RSM Bee team leg.; ex *Helianthus annuus*; RSKM • 1♀; Division 11, Saskatoon; [52.1333° N, 106.6667° W]; 28 Jul. 1940; Joyce J.W. leg.; CNC • 5♀♀; Division 2, Bengough; 49.2899° N, 105.1141° W; 07 Jul. 2013; Heisler L., Gallon A. leg.; RSKM • 1♀, 2♂♂; Division 2, Bengough; 49.2736° N, 105.1237° W; 27 Jul. 2013; Heisler L., Gallon A. leg.; RSKM • 1♀, 1♂; Division 2, Bengough; 49.2484° N, 105.406° W; 29 Jul. 2013; Heisler L., Gallon A. leg.; RSKM • 1♀; Division 2, Bengough; 49.2515° N, 105.4034° W; 31 Jul. 2013; Gallon A. leg.; RSKM • 1♂; Division 2, Bengough; 49.2089° N, 105.0827° W; 07 Jul. 2013; Heisler L., Gallon A. leg.; RSKM • 1♀, 1♂; Division 2, Bengough, Big Muddy; 49.2056° N, 105.243° W; 07 Jul. 2013; Gallon A. leg.; RSKM • 1♀, 1♂; Division 2, Bengough, Big Muddy; 49.2181° N, 105.2209° W; 08 Jul. 2013; Gallon A. leg.; RSKM • 8♀♀, 1♂; Division 3, Flintoft; 49.5123° N, 106.3434° W; 18 Jul. 2013; Sheffield C. leg.; RSKM • 1♂; Division 3 , Rockglen; [49.1833° N, 105.95° W]; 03 Aug. 1955; Miller C.D. leg.; CNC • 1♀; Division 4, Cypress Hills; 49.5708° N, 109.8966° W; 13 Jul. 2013; Sheffield C. leg.; RSKM • 1♀, 2♂♂; Division 4, Grasslands National Park; 49.1432° N, 107.4468° W; 11 Jul. 1996; Finnamore A.T. leg.; PMAE • 1♀; Division 4, Grasslands National Park; 49.1315° N, 107.5992° W; 13 Jul. 1996; Finnamore A.T. leg.; PMAE • 2♀♀; Division 4, Grasslands National Park; 49.1432° N, 107.4468° W; 23 Jul. 1996; Finnamore A.T. leg.; PMAE • 1♀, 1♂; Division 4, Grasslands National Park; 49.1406° N, 107.3907° W; 20 Jul. 1996; Finnamore A.T. leg.; PMAE

• 1♂; Division 4, Grasslands National Park; 49.1432° N, 107.4468° W; 27 Jul. 1996; Finnamore A.T. leg.; PMAE • 1♂; Division 4, Grasslands National Park; 49.1799° N, 107.4005° W; 02 Jul. 1996; Finnamore A.T. leg.; PMAE • 2♂♂; Division 4, Grasslands National Park; 49.1432° N, 107.4468° W; 14 Jul. 1996; Finnamore A.T. leg.; PMAE • 1♀, 1♂; Division 4, Grasslands National Park; 49.1799° N, 107.4005° W; 14 Jul. 1996; Finnamore A.T. leg.; PMAE • 1♂; Division 4, Grasslands National Park; 49.1432° N, 107.4468° W; 22 Jul. 1996; Finnamore A.T. leg.; PMAE • 4♂♂; Division 4, Grasslands National Park; 49.1799° N, 107.4005° W; 27 Jul. 1996; Finnamore A.T. leg.; PMAE • 1♂; Division 4, Grasslands National Park; 49.1791° N, 107.4072° W; 23 Jul. 1996; Finnamore A.T. leg.; PMAE • 1♂; Division 4, Grasslands National Park; 49.1371° N, 107.6149° W; 28 Jul. 1996; Finnamore A.T. leg.; PMAE • 2♂♂; Division 4, Grasslands National Park; 49.2148° N, 107.6476° W; 17 Jul. 1996; Finnamore A.T. leg.; PMAE • 6♂♂; Division 4, Grasslands National Park; 49.1643° N, 107.4351° W; 23 Jul. 1996; Finnamore A.T. leg.; PMAE • 1♀, 1♂; Division 4, Grasslands National Park; 49.2148° N, 107.6476° W; 09 Jul. 1996; Finnamore A.T. leg.; PMAE • 1♂; Division 4, Grasslands National Park; 49.1315° N, 107.5992° W; 25 Jul. 1996; Finnamore A.T. leg.; PMAE • 1♂; Division 4, Grasslands National Park; 49.1799° N, 107.4005° W; 23 Jul. 1996; Finnamore A.T. leg.; PMAE • 1♂; Division 4, Grasslands National Park; 49.1315° N, 107.5992° W; 19 Jul. 1996; Finnamore A.T. leg.; PMAE • 1♂; Division 4, Grasslands National Park; 49.0624° N, 107.6548° W; 13 Jul. 1996; Finnamore A.T. leg.; PMAE • 1♀, 2♂♂; Division 4, Grasslands National Park; 49.1406° N, 107.3907° W; 28 Jul. 1996; Finnamore A.T. leg.; PMAE • 2♀♀, 1♂; Division 4, Grasslands National Park; 49.1315° N, 107.5992° W; 13 Jul. 1996; Finnamore A.T. leg.; PMAE • 1♂; same location as preceding; 08 Jul. 1996; Finnamore A.T. leg.; PMAE • 1♂; Division 4, Grasslands National Park; 49.1432° N, 107.4468° W; 27 Jul. 1996; Finnamore A.T. leg.; PMAE • 1♀, 3♂♂;

Division 4, Grasslands National Park; 49.1791° N, 107.4072° W; 27 Jul. 1996; Finnamore A.T. leg.; PMAE • 1♂; Division 4, Grasslands National Park; 49.1432° N, 107.4468° W; 23 Jul. 1996; Finnamore A.T. leg.; PMAE • 6♂♂; Division 4, Grasslands National Park; 49.2148° N, 107.6476° W; 25 Jul. 1996; Finnamore A.T. leg.; PMAE • 1♀, 2♂♂; Division 4, Grasslands National Park; 49.1371° N, 107.6149° W; 25 Jul. 1996; Finnamore A.T. leg.; PMAE • 1♀, 2♂♂; Division 4, Grasslands National Park; 49.2148° N, 107.6476° W; 13 Jul. 1996; Finnamore A.T. leg.; PMAE • 1♀; Division 4, Grasslands National Park; 49.1791° N, 107.4072° W; 14 Jul. 1996; Finnamore A.T. leg.; PMAE • 1♀; Division 4, Grasslands National Park; 49.1643° N, 107.4351° W; 15 Jul. 1996; Finnamore A.T. leg.; PMAE • 1♀, 3♂♂; Division 4, Grasslands National Park; 49.0624° N, 107.6548° W; 09 Jul. 1996; Finnamore A.T. leg.; PMAE • 2♀♀; Division 4, Grasslands National Park; 49.2148° N, 107.6476° W; 29 Jul. 1996; Finnamore A.T. leg.; PMAE • 1♀; Division 4, Grasslands National Park; 49.1799° N, 107.4005° W; 10 Jul. 1996; Finnamore A.T. leg.; PMAE • 1♂; Division 4, Old Man on His Back Conservation Area; 49.2258° N, 109.1818° W; 25 Jul. 2018; RSM Bee team leg.; RSKM • 1♀, 10♂♂; Division 4, Orkney; 49.1451° N, 107.8538° W; 26 Aug. 2018; Oram R. leg.; ex *Helianthus annuus*; RSKM • 2♀♀; same location as preceding; 26 Aug. 2018; DeMeyer C. leg.; ex *Helianthus annuus*; RSKM • 2♀♀; Division 7, Waldeck; 50.3881° N, 107.4679° W; 22 Jul. 2013; Sheffield C. leg.; RSKM

MEXICO – **Coahuila** • 1♂; Saltillo (15 mi. S); [25.17° N, 101.1° W]; 08 Jul. 1983; Kovarik Harrison Schaffner leg.; TAMUIC – **Hidalgo** • 1♀; Zacatlan (23.5 mi NW); [20.138° N, 98.2552° W]; 22 Aug. 1962; Roberts R.B. leg.; SEMC – **Nuevo Leon** • 1♂; Monterey; [25.7° N, 100.3° W]; 27 Apr. 1969; Teskey H.J. leg.; CNC – **Sonora** • 1♀; Myacoba (10 km E); 18 Aug. 1991; Rozen J.G., Pember N. leg.; INHS

USA – **Arizona** • 2♂♂; Apache, McNary, Bog Creek; [34.0539° N, 109.7556° W]; 16 Aug. 2001; Kwapong P. leg.; SEMC • 2♂♂; Cochise, Willcox; [32.2529° N, 109.832° W]; 09 Aug. 1933; Bryant O. leg.; CAS • 1♂; Coconino, Flagstaff; [35.1983° N, 111.6513° W]; 19 Jul. 1950; Michener C.D. leg.; ex *Helianthus annuus*; SEMC • 1♂; Coconino, Flagstaff, San Francisco Mountains; [35.3408° N, 111.6832° W]; elev. 3353 m.; 12 Aug. 1935; Lutz F.E. leg.; AMNH • 2♂♂; Coconino, Fort Valley; [35.2682° N, 111.728° W]; 24 Jul. 1964; Poole R.W. leg.; CUIC • 1♀; Coconino, Grand Canyon National Park; [36.1069° N, 112.113° W]; 17 Aug. 1968; Michener C.D. leg.; ex *Chamaebatiaria millefolium*; SEMC • 1♀; same location as preceding; 16 Aug. 1968; Michener C.D. McGee E.K. leg.; ex *Chamaebatiaria millefolium*; SEMC • 1♂; Cruz, Santa Rita Mountains; [31.8259° N, 110.7748° W]; 14 Aug. 1940; VanDyke E.J. leg.; CAS • 1♀, 1♂; Gila, Carrizo; [33.9939° N, 110.2887° W]; 18 Jul. 1950; Knull D.J., J.N. leg.; OSUC • 1♀, 2♂♂; Graham, Coronado National Forest, Hospital Flat; [32.6675° N, 109.8764° W]; 13 Aug. 2018; ex *Hymenoxys hoopesii*; OSAC: LP • 1♀, 1♂; same location as preceding; 14 Aug. 2018; ex *Heracleum maximum*; OSAC: LP • 1♀, 1♂; Graham, Graham Mountains; [32.7017° N, 109.8715° W]; elev. 2743 m.; 16 Aug. 1953; Butler G.D. leg.; AMNH • 1♀; Graham, Mount Graham; [32.7017° N, 109.8715° W]; 25 Jul. 1933; Parker leg.; CAS • 1♀, 1♂; same location as preceding; 26 Jul. 1933; Parker leg.; CAS • 3♀♀, 3♂♂; same location as preceding; 26 Jul. 1933; Parker leg.; CAS • 4♀♀, 17♂♂; same location as preceding; 12 Aug. 1933; Bryant O. leg.; CAS • 1♀, 1♂; same location as preceding; 25 Aug. 1933; Parker leg.; CAS • 9♂♂; same location as preceding; 15 Aug. 1933; Bryant O. leg.; CAS • 2♂♂; Graham, Pinaleno Mountains, Hospital Flat; [32.6676° N, 109.877° W]; elev. 2758 m.; 19 Aug. 1932; Leech H.B., Green J.W. leg.; CAS • 5♀♀, 6♂♂; same location as preceding; 03 Aug. 1965; Leech H.B. leg.; CAS • 5♀♀, 3♂♂; same location as preceding; 02 Aug. 1965; Leech H.B. leg.; CAS • 1♀; Graham,

Pinaleno mountains, Hospital Flat; [32.7014° N, 109.8717° W]; 13 Aug. 2018; ex Cirsium parryi; OSAC: LP • 8♀♀, 4♂♂; same location as preceding; 13 Aug. 2018; ex *Hymenoxys hoopesii*; OSAC: LP • 3♂♂; same location as preceding; 14 Aug. 2018; ex *Hymenoxys hoopesii*; OSAC: LP • 2♀♀, 4♂♂; Graham, Pinaleno mountains, Hospital Flat; 32.6684° N, 109.8776° W; 13 Aug. 2012; ex *Hymenoxys hoopesii*; OSAC: LP • 2♀♀, 4♂♂; same location as preceding; 12 Aug. 2012; ex *Hymenoxys hoopesii*; OSAC: LP • 1♀; same location as preceding; 09 Aug. 2012; ex *Hymenoxys hoopesii*; OSAC: LP • 1♀; same location as preceding; 11 Aug. 2012; ex *Hymenoxys hoopesii*; OSAC: LP • 1♂; Graham, Pinaleno mountains, Hospital Flat; [32.7014° N, 109.8717° W]; 12 Aug. 2018; ex *Hymenoxys hoopesii*; OSAC: LP • 1♂; Greenlee, Santa Catalina Mountains, Bear Wallow Ravine to Mount Lemmon; [32.4243° N, 110.7394° W]; 14 Jul. 1916; AMNH • 2♀♀; Pima, Coronado National Forest, Mt. Lemmon; [32.4432° N, 110.7577° W]; 01 Aug. 1957; Knull D.J., J.N. leg.; OSUC • 1♂; same location as preceding; 01 Aug. 1992; Eickwort G.C. leg.; CUIC • 3♀♀; Pima, Santa Catalina Mountains; [32.443° N, 110.788° W]; 20 Jul. 1942; VanDyke E.J. leg.; CAS • 1♀; same location as preceding; 21 Jul. 1942; VanDyke E.J. leg.; CAS • 2♂♂; same location as preceding; 15 Aug. 1938; Bryant O. leg.; CAS • 6♂♂; Yavapai, Chino Valley (5 mi. N); [34.7575° N, 112.4538° W]; 12 Aug. 1997; Rozen J.G., Rozen B.L. leg.; ex *Helianthus* sp.; AMNH • 1♂; Yavapai, Jerome, Mingus Mountain; [34.6939° N, 112.1277° W]; 31 Aug. 1964; Michener C.D., D.R. leg.; ex *Sphaeralcea* sp.; SEMC – **Arkansas** • 2♂♂; Sebastian, Fort Smith, Witcherville; [35.1376° N, 94.2644° W]; 25 May. 1984; Freihofer L.G. leg.; CAS – **Colorado** • 7♂♂; Alamosa, South of Great Sand Dunes National Monument; 37.6859° N, 105.5446° W; 29 Jul. 1977; Brown F.M. leg.; ex *Helianthus annuus*; UCMC • 2♂♂; Baca, Springfield; [37.4083° N, 102.6144° W]; 07 Jul. 1978; Bohart G.E. leg.; ex *Helianthus*; UCMC • 1♀, 1♂; Boulder, Boulder; 40.015° N, 105.2706° W;

elev. 1667 m.; 22 Jul. 1913; Cockerell T.D.A. leg.; ex *Helianthus*; UCMC • 4♂♂; same location as preceding; 03 Jul. 1966; Lanham U.N. leg.; ex *Helianthus*; UCMC • 1♂; same location as preceding; 08 Aug. 1906; Cockerell W.P. leg.; ex *Helianthus*; UCMC • 1♂; Boulder, Boulder; [40.015° N, 105.2705° W]; 14 Aug. 1935; Michener C.D. leg.; CAS • 1♀; same location as preceding; 20 Aug. 1935; Michener C.D. leg.; CAS • 1♀; Boulder, East of Main along St. Vrain Greenway in Longmont; 40.1551° N, 105.096° W; elev. 1507 m.; 27 Jul. 2020; Mullins J.L. leg.; ex *Helianthus annuus*; UCMC • 5♀♀, 4♂♂; same location as preceding; 17 Jun. 2020; Mullins J.L. leg.; ex *Ratibida pinnata*; UCMC • 1♀; Boulder, Golden Ponds along St. Vrain Greenway in Longmont; 40.1686° N, 105.1408° W; elev. 1527 m.; 04 Sep. 2014; Scott V.L. leg.; ex *Helianthus annuus*; UCMC • 2♀♀, 1♂; Boulder, Gunbarrel; 40.066° N, 105.171° W; elev. 1613 m.; 20 Aug. 1981; Robinson P. leg.; ex *Helianthus*; UCMC • 1♀; Boulder, Hygiene; 40.189° N, 105.18° W; elev. 1551 m.; 17 Jul. 1936; Bauer R. leg.; UCMC • 1♀; Boulder, Jim Creek near Boulder; [39.8796° N, 105.7291° W]; elev. 1951 m.; 08 Jul. 1922; UCMC • 1♀; Boulder, Longmont, East of Main along St. Vrain Greenway in Longmont; 40.1551° N, 105.096° W; elev. 1507 m.; 17 Jun. 2020; Mullins J.L. leg.; ex *Ratibida pinnata*; UCMC • 1♀; Boulder, Louisville, Hwy 128 & 93 (1.6 km S); 39.9147° N, 105.2386° W; elev. 1815 m.; 25 Jun. 2004; Kearns C.A. leg.; UCMC • 1♂; Boulder, Lykins Gulch along St. Vrain Greenway in Longmont; 40.1627° N, 105.1441° W; elev. 1530 m.; 01 Jul. 2014; Scott V.L. leg.; ex *Ratibida pinnata*; UCMC • 1♀; Boulder, Lykins Gulch along St. Vrain Greenway in Longmont; 40.1671° N, 105.1413° W; elev. 1529 m.; 08 Aug. 2014; UCMC • 1♂; Boulder, Nederland; [39.9614° N, 105.5108° W]; 17 Aug. 1940; Milliron H.E. leg.; UMSP • 1♂; Boulder, Peaceful Valley; 40.1307° N, 105.4971° W; elev. 2556 m.; 26 Aug.; Cockerell T.D.A. leg.; ex *Helianthus*; UCMC • 2♂♂; Boulder, Sugarmill along St. Vrain Greenway in Longmont; 40.1545° N, 105.0849° W; elev. 1503 m.; 21

Aug. 2012; Scott V.L. leg.; ex *Helianthus annuus*; UCMC • 1♀; same location as preceding; 08 Jul. 2020; Mullins J.L. leg.; ex *Helianthus annuus*; UCMC • 1♀; Boulder, Sugarmill along St. Vrain Greenway in Longmont; 40.1532° N, 105.0748° W; elev. 1496 m.; 02 Sep. 2014; UCMC • 1♀; Boulder, Western Mobile BCPOS; 40.206° N, 105.2241° W; elev. 1598 m.; 21 Jul. 2016; UCMC • 1♂; Boulder; 39.9614° N, 105.5105° W; elev. 2507 m.; 24 Jun. 1925; Custer C.P. leg.; UCMC • 1♀, 1♂; Boulder; 40.015° N, 105.2706° W; elev. 1667 m.; 22 Jun. 1922; Jackson L.O. leg.; ex *Helianthus pumilus*; UCMC • 1♀; Boulder; 40.094° N, 105.347° W; 10 Aug. 1925; Hicks C.H. leg.; UCMC • 1♀; same location as preceding; 07 Aug. 1925; Hicks C.H. leg.; UCMC • 1♂; Boulder; [40.1512° N, 105.5005° W]; elev. 1768 m.; 22 Jun. 1977; Lanham U.N. leg.; UCMC • 1♀; same location as preceding; 03 Jul. 1980; Lanham U.N. leg.; UCMC • 3♀♀; same location as preceding; 03 Jul. 1966; Lanham U.N. leg.; ex *Helianthus*; UCMC • 1♀; same location as preceding; 06 Jun. 1968; Lanham U.N. leg.; UCMC • 1♂; Boulder , Boulder; [40.015° N, 105.2705° W]; 04 Sep.; Cockerell T.D.A. leg.; ex *Helianthus* sp.; CNC • 3♀♀, 9♂♂; Clear Creek, Chicago Creek; [39.681° N, 105.6253° W]; elev. 2682 m.; 02 Aug. 1961; Poole B.H. leg.; CNC • 2♂♂; same location as preceding; 02 Aug. 1961; Mason W.R.M. leg.; CNC • 1♀, 3♂♂; same location as preceding; 05 Aug. 1961; Clark S.M. leg.; CNC • 4♂♂; Clear Creek, Idaho Springs; [39.7425° N, 105.5136° W]; elev. 2438 m.; 27 Jul. 1961; Mann C.H. leg.; CNC • 1♀, 1♂; El Paso, Calhan; [39.0355° N, 104.2972° W]; 08 Jul. 1970; Brothers D., Michener C.D. leg.; ex *Helianthus petiolaris*; SEMC • 1♂; El Paso, Colorado Springs, Garden of Gods; [38.8784° N, 104.8698° W]; 05 Aug. 1982; Eickwort G.C. leg.; CUIC • 1♂; El Paso, Foster Ranch; 38.734° N, 104.6503° W; elev. 1737 m.; 10 Jul. 1977; Brown F.M. leg.; UCMC • 1♀; same location as preceding; 25 Jun. 1977; Brown F.M. leg.; ex *Asclepias*; UCMC • 1♂; El Paso, Solar Trails County Park; 38.8307° N, 104.8818° W; elev. 1981 m.; 12 Jul. 1980; Brown

F.M. leg.; UCMC • 1♂; same location as preceding; 12 Jul. 1980; Brown F.M. leg.; ex *Apocynum*; UCMC • 1♀; Grand, Winter Park, Jim Creek; [39.8806° N, 105.7437° W]; elev. 1951 m.; 25 Jul. 1922; SEMC • 1♀; same location as preceding; 05 Jul. 1922; AMNH • 2♂♂; same location as preceding; 08 Jul. 1922; AMNH • 1♂; Jefferson, Arvada, Applewood Seed Co.; Trial Gardens; 39.7938° N, 105.1354° W; elev. 1672 m.; 28 Jun. 2012; Wilson D. leg.; ex *Dracopis amplexicaulis*; UCMC • 1♀, 1♂; same location as preceding; 22 Jun. 2010; Wilson D. leg.; ex *Coreopsis* lancelota; UCMC • 2♂♂; Jefferson, Golden; [39.7555° N, 105.2211° W]; elev. 2255 m.; 31 Aug. 1961; Clark S.M. leg.; CNC • 1♂; same location as preceding; 31 Jul. 1961; Mason W.R.M. leg.; CNC • 1♀, 1♂; Jefferson, Wheatridge; [39.7661° N, 105.0772° W]; 17 Jul. 1933; Cockerell T.D.A. leg.; ex *Helianthus annuus*; CAS • 1♀, 1♂; Kit Carson, Brouwer; 39.3943° N, 103.0474° W; elev. 1461 m.; 21 Aug. 2013; UCMC • 2♂♂; same location as preceding; 25 Aug. 2013; UCMC • 1♂; same location as preceding; 22 Aug. 2014; UCMC • 1♂; same location as preceding; 01 Aug. 2014; UCMC • 2♂♂; Kit Carson, CLAPPER1; 39.2602° N, 102.7715° W; elev. 1391 m.; 01 Jul. 2014; UCMC • 1♂; Kit Carson, Pickard; 39.3044° N, 102.7133° W; elev. 1373 m.; 13 Jun. 2014; UCMC • 1♀; same location as preceding; 31 Jul. 2014; UCMC • 1♂; Kit Carson, Schulte; 39.2645° N, 102.6681° W; elev. 1356 m.; 28 Jun. 2013; UCMC • 1♂; same location as preceding; 22 Aug. 2014; UCMC • 1♂; same location as preceding; 01 Jul. 2014; UCMC • 1♂; Larimer, Estes Park; [40.3772° N, 105.5217° W]; elev. 2256 m.; 23 Jul. 1916; AMNH • 1♂; Larimer, Glen Haven; [40.4539° N, 105.4491° W]; 25 Jul. 1947; Lawson P.B., E.R. leg.; SEMC • 1♂; Las Animas, Cucharas Pass (4 mi. SE); [37.3198° N, 105.0725° W]; elev. 2896 m.; 09 Aug. 1977; Lanham U.N., Byron P. leg.; ex Alium; UCMC • 1♀, 1♂; Las Animas, Trinidad Lake State Park; [37.146° N, 104.5758° W]; 09 Aug. 1977; Lanham U.N. leg.; UCMC • 1♀; Las Animas, Valdez (5 mi. E); [37.1334° N, 104.61° W]; 12

Aug. 1964; Rozen J.G., Rozen B.L., Rozen K.C. leg.; AMNH • 1♂; Logan, Bauden; 40.5211° N, 102.972° W; elev. 1348 m.; 28 Jun. 2013; UCMC • 1♂; Logan, HAM2; 40.539° N, 102.6728° W; elev. 1252 m.; 21 Aug. 2014; UCMC • 1♀; Logan, MERTENS; 40.5349° N, 103.4758° W; elev. 1328 m.; 21 Aug. 2013; UCMC • 1♂; Montezuma, Cortez; 37.3489° N, 108.5853° W; elev. 1883 m.; 03 Sep. 1989; Peigler R.S. leg.; UCMC • 1♀; Montrose, Nucla (7 mi. NW); 38.4114° N, 108.6034° W; elev. 2438 m.; 17 Sep. 1975; Lanham U.N. leg.; ex Viguera; UCMC • 1♂; Mount Evans, Doolittle Ranch; [39.5994° N, 105.7335° W]; elev. 2987m m.; 19 Jul. 1964; Dasch C. leg.; OSUC • 1♀; Otero, La Junta; 37.9833° N, 103.5166° W; elev. 1250 m.; 12 Aug. 1920; SEMC • 1♀; Park, 11-Mile Canyon; [38.9067° N, 105.47° W]; elev. 2438 m.; 15 Jul. 1954; Evans H.E., Evans M.A. leg.; CUIC • 1♀; Park, Jefferson, Coal Creek Canyon; [39.3772° N, 105.8006° W]; 16 Aug. 1962; Vogel B. leg.; ex *Helianthus*; UCMC • 1♂; Phillips, DUNBAR; 40.6683° N, 102.5849° W; elev. 1218 m.; 02 Aug. 2014; UCMC • 1♀; Phillips, Dunbar; 40.6683° N, 102.5849° W; elev. 1218 m.; 26 Jun. 2014; UCMC • 1♀; Phillips, Ham3; 40.4942° N, 102.534° W; elev. 1207 m.; 23 Aug. 2013; UCMC • 2♀♀, 2♂♂; Phillips, Ham4; 40.5621° N, 102.4776° W; elev. 1192 m.; 23 Aug. 2013; UCMC • 6♀♀, 3♂♂; Phillips, Lenz; 40.5255° N, 102.3843° W; elev. 1162 m.; 23 Aug. 2013; UCMC • 1♀; Saguache, Poncha Pass; 38.4223° N, 106.0875° W; elev. 2754 m.; 20 Sep. 1980; Brown F.M. leg.; ex *Symphyotrichum* sp.; UCMC • 1♂; Teller, Florissant, Florissant Fossil Beds National Monument Headquarters area; 38.9063° N, 105.2791° W; elev. 2560-2591 m.; 26 Aug. 1982; Brown F.M. leg.; UCMC • 2♂♂; Teller, Woodland Park (7 mi. N), South Meadows Camp; 39.0639° N, 105.0955° W; elev. 2438 m.; 21 Jul. 1977; Peck S., Peck J. leg.; PMAE • 3♀♀, 1♂; Washington, CRONK; 39.7722° N, 103.4595° W; elev. 1469 m.; 21 Aug. 2014; UCMC • 1♀; same location as preceding; 01 Aug. 2014; UCMC • 4♂♂; Washington, Ernst; 39.7628° N, 103.0836° W; elev. 1431 m.; 02 Jul.

2013; UCMC • 1♂; same location as preceding; 01 Aug. 2014; UCMC • 1♀; Washington, Leach; 39.8734° N, 103.4244° W; elev. 1432 m.; 28 Jun. 2013; UCMC • 2♀♀; Washington; 39.8284° N, 103.3835° W; elev. 1460 m.; 27 Jun. 2014; Wright K. leg.; UCMC • 1♀, 1♂; Washington; 39.8983° N, 103.3139° W; elev. 1485 m.; 28 Jun. 2013; Wright J. leg.; UCMC • 1♂; Weld, Central Plains Experimental Range; [40.8413° N, 104.7173° W]; 30 Jun. 1976; Scott J.A. leg.; ex *Thelesperma filifolium*; ESUW • 1♀; Weld, Pawnee Grassland; [40.843° N, 104.0935° W]; 14 Jul. 1975; Lavigne R. leg.; ESUW • 1♀; Yuma, Beecher Island (2-5 mi. S); [39.8719° N, 102.1853° W]; 24 Jun. 1979; Lanham U.N. leg.; ex *Sphaeralcea*; UCMC • 1♀, 1♂; Yuma, Newton1; 40.0887° N, 102.4643° W; elev. 1187 m.; 15 Jul. 2013; UCMC – **Illinois** • 2♀♀, 2♂♂; Champaign; 40.1307° N, 88.1444° W; 23 Aug. 2019; Harmon-Threatt leg.; ex *Rudbeckia hirta*; USDA IL • 1♂; Iroquois, Buckley (1 mi. W); [40.5968° N, 88.0575° W]; 23 Jun. 1967; Ribble D.W. leg.; ex *Rudbeckia* sp.; INHS • 2♂♂; Lee, Nachusa; 41.9041° N, 89.3273° W; 26 Jun. 2014; Bruninga B. leg.; WRME • 1♀; Lee, Nachusa; 41.899° N, 89.3667° W; 26 Jun. 2014; Bruninga B. leg.; WRME • 2♀♀; same location as preceding; 10 Aug. 2014; Kerr M. leg.; WRME • 1♂; Lee, Nachusa; 41.8789° N, 89.3423° W; 13 Jun. 2013; Kerr M. leg.; WRME • 19♀♀, 16♂♂; Macoupin, Carlinville; [39.2798° N, 89.8818° W]; Robertson C. leg.; INHS • 1♂; same location as preceding; 11 Jun.; Robertson C. leg.; INHS • 1♀; same location as preceding; 01 May. 1929; Robertson C. leg.; INHS • 1♀; same location as preceding; 05 Sep.; Robertson C. leg.; INHS • 1♂; same location as preceding; 02 Aug. 1971; Marlin J.C. leg.; ex *Rudbeckia triloba*; INHS • 1♂; same location as preceding; 07 Aug. 1971; Marlin J.C. leg.; ex *Rudbeckia hirta*; INHS • 1♀; Vermilion; 40.1264° N, 87.812° W; 07 Jul. 2019; Leonard R. leg.; ex *Ratibida pinnata*; USDA IL • 2♀♀; Vermilion; 40.1223° N, 87.8125° W; 06 Jul. 2019; Leonard R. leg.; ex *Rudbeckia hirta*; USDA IL • 1♂; Nachusa grasslands; [41.8789° N, 89.3423°

W]; 13 Jun. 2014; Kerr M. leg.; RUIC: RW • 1♀; Nachusa grasslands; [41.8949° N, 89.3064° W]; 27 Aug. 2013; S Griffin leg.; RUIC: RW • 1♀, 1♂; Nachusa grasslands; [41.899° N, 89.3667° W]; 13 Jun. 2014; Kerr M. leg.; RUIC: RW • 1♀; Nachusa grasslands; [41.8729° N, 89.3574° W]; 13 Jun. 2014; Kerr M. leg.; RUIC: RW • 1♀, 1♂; Nachusa grasslands; [41.899° N, 89.3667° W]; 26 Jun. 2014; B Bruninga-Socolar leg.; RUIC: RW • 1♀; Nachusa grasslands; [41.9012° N, 89.3626° W]; 26 Jun. 2014; B Bruninga-Socolar leg.; RUIC: RW • 2♀♀, 1♂; Nachusa grasslands; [41.9041° N, 89.3273° W]; 26 Jun. 2014; B Bruninga-Socolar leg.; RUIC: RW • 1♀; Nachusa grasslands; [40.5006° N, 74.5639° W]; 25 Apr. 2016; CK leg.; ex Potentilla indica; RUIC: RW • 1♀; Nachusa grasslands; [41.883° N, 89.3248° W]; 26 Jun. 2014; B Bruninga-Socolar leg.; RUIC: RW • 1♀; Nachusa grasslands; [41.9033° N, 89.3339° W]; 26 Jun. 2014; B Bruninga-Socolar leg.; RUIC: RW • 2♀♀; Nachusa grasslands; [41.899° N, 89.3667° W]; 10 Aug. 2014; Kerr M. leg.; RUIC: RW – **Iowa** • 1♀; Page, Shenandoah (2 mi. NE); 40.7913° N, 95.351° W; elev. 297 m.; 26 Jun. 2000; Scott V.L. leg.; UCMC • 1♂; Beenken; [42.0905° N, 92.3388° W]; 30 Jun. 2018; UNI: AW • 2♀♀, 1♂; BrindleTwo; [42.2247° N, 92.9352° W]; Jun. 2018; UNI: AW • 1♂; CRERS; [42.3833° N, 92.2167° W]; 16 Jun. 2015; UNI: AW • 3♀♀, 1♂; Kimmerle; [42.5615° N, 91.547° W]; 11 Jul. 2019; ex *Rudbeckia hirta*; UNI: AW • 1♀; same location as preceding; 11 Jul. 2019; ex *Echinacea purpurea*; UNI: AW • 3♀♀, 2♂♂; same location as preceding; 14 Aug. 2019; ex *Echinacea purpurea*; UNI: AW • 6♀♀, 3♂♂; Moseley; [42.3997° N, 92.4907° W]; 13 Jun. 2018; UNI: AW • 1♀; same location as preceding; 09 Jul. 2018; ex *Ratibida pinnata*; UNI: AW • 1♂; Reiher; [42.7164° N, 92.8575° W]; 13 Aug. 2019; ex *Heliopsis helianthoides*; UNI: AW • 1♀; Shonka; [42.8643° N, 92.0831° W]; 12 Jul. 2019; ex *Ratibida pinnata*; UNI: AW • 1♀; Sindelar; [41.9664° N, 91.9476° W]; 11 Jul. 2018; ex *Rudbeckia hirta*; UNI: AW – **Kansas** • 1♂; Barton; [38.3614° N, 98.7651° W];

elev. 554 m.; Hunter S.J. leg.; SEMC • 1♀, 3♂♂; Douglas, Lawrence; [38.9717° N, 95.2353° W]; 22 Jun. 1996; Danforth B.N. leg.; CUIC • 1♂; same location as preceding; 08 Sep. 1999; Wahl D.B. leg.; SEMC • 6♀♀, 9♂♂; same location as preceding; 23 Jun. 1985; Brooks R.W. leg.; ex *Rudbeckia hirta*; SEMC • 1♀; Finney, Garden City; [37.9717° N, 100.8727° W]; 19 Jun. 1952; Michener C.D., Willie. leg.; ex *Meliotus officinalis*; SEMC • 1♂; Ford, Ford City; [37.6361° N, 99.754° W]; 11 Jun. 1952; Michener C.D., Willie. leg.; ex Quincula lobata; SEMC • 1♀; Hamilton, Syracuse; [37.9806° N, 101.7527° W]; 04 Jun. 1952; Beamer L.D. leg.; SEMC • 1♀, 1♂; Marshall, Blue Rapids; [39.6819° N, 96.6597° W]; 03 Jul. 1924; Stevens O.A. leg.; ex *Echinacea pallida*; AMNH • 1♀; same location as preceding; 18 Jun. 1919; Stevens O.A. leg.; ex *Echinacea pallida*; AMNH • 1♀; same location as preceding; 16 Jun. 1922; Stevens O.A. leg.; ex *Echinacea pallida*; AMNH • 1♂; Montgomery, Coffeyville; [37.0373° N, 95.6164° W]; 14 Jun. 1953; Beer R.E. leg.; SEMC • 1♀; Sheridan, Quinter; [39.0695° N, 100.2324° W]; 18 Jun. 1950; Michener C.D. leg.; ex *Helianthus petiolaris*; AMNH • 1♀; Sherman, Sherman State Reservoir, Goodland (10 mi SW); [41.2896° N, 98.9094° W]; 10 Jun. 1988; Eickwort G.C. leg.; CUIC – **Kansas** or **Colorado** • 1♀, 1♂; SEMC – **Michigan** • 1♂; Berrien, Southwest Michigan Research and Education Center; [42.084° N, 88.3535° W]; 23 Aug. 2016; ex *Coreopsis* tripteris; MSUC: RI – **Minnesota** • 1♀; Benton, Sartell WMA; 45.78° N, 94.1967° W; 15 Aug. 2018; Gedlinske L. leg.; ex *Helianthus pauciflorus*; MNDNR • 2♂♂; Dakota, Hastings Sand Coulee SNA; 44.6936° N, 92.819° W; 31 Aug. 2017; Arndofer A. leg.; ex *Helianthus pauciflorus*; MNDNR • 1♀; Goodhue, Frontenac State Park; 44.5245° N, 92.3421° W; 01 Aug. 2017; Gerjets N. leg.; ex *Rudbeckia hirta*; MNDNR • 1♀; Houston, Houston; 43.7852° N, 91.6235° W; 04 Jul. 2014; Leddy S. leg.; WRME • 1♂; Nicolet, Swan Lake WMA; 44.3394° N, 94.28° W; 17 Jun. 2010; Kern C. leg.; MNDNR • 1♂; Stevens, Klason WMA; 45.6424° N, 95.8746° W; 18 Jul.

2015; Jokela K. leg.; ex *Ratibida pinnata*; MNDNR • 1♀; Washington, Point Douglas Cemetery; [44.7652° N, 92.825° W]; 28 Aug. 1992; Reed C. leg.; UMSP • 1♂; same location as preceding; 29 Aug. 1991; Reed C. leg.; UMSP – **Missouri** • 3♂♂; Benson, Truman State Park; [38.2856° N, 93.4621° W]; 04 Jul. 1995; Brown R.L. leg.; MEM • 1♀; Cedar, Sky Prairie CA, T34N R28W sec 13 (NE1/4); [37.693° N, 93.946° W]; 07 Jul. 2009; Jean R.P. leg.; ex *Rudbeckia hirta*; RJPC • 1♂; St. Clair, Wahkontah Prairie, T36N R28W Sec 10 (SW1/4); [37.903° N, 94° W]; 06 Jul. 2009; Jean R.P. leg.; ex *Rudbeckia hirta*; RJPC • 1♂; St. Clair, Wahkontah Prairie, T36N R28W Sec 3 (S1/2); [37.916° N, 94° W]; 12 Sep. 2007; Jean R.P. leg.; ex *Bidens aristosa*; RJPC – **Montana** • 2♀♀, 4♂♂; Carbon, Bridger (1 mi. SE); [45.2825° N, 108.9244° W]; 11 Jul. 2007; Pearce A.M. leg.; ex *Ratibida pinnata*; MTEC • 1♀; same location as preceding; 18 Jul. 2006; Pearce A.M., O'Niell leg.; ex *Dalea candida*; MTEC • 1♀; Carter, Baker (23 mi. S), Old Number 7 Road; 46.0404° N, 104.3925° W; elev. 964 m.; 21 Jul. 2020; Pritchard Z.A., Botti J. leg.; MTEC • 1♀; Carter, Medicine Rocks State Park; 46.0416° N, 104.4838° W; elev. 1045 m.; 20 Jul. 2020; Pritchard Z.A., Botti J. leg.; MTEC • 2♀♀, 2♂♂; Cascade, Great Falls former refinery, East ditch drainage area (NE of Great Falls E of Black Eagle); [47.525° N, 111.26° W]; 25 Jul. 2018; Seibert C.E. leg.; ex *Helianthus annuus*; CESC • 1♂; Chouteau, Big Sandy; 48.0443° N, 110.0695° W; 23 Jul. 2014; Adhikari S. leg.; MTEC • 1♀; Custer, Miles City (4 mi. S); [46.3503° N, 105.8249° W]; 11 Jul. 1984; Hall P. leg.; MTEC • 1♀; Daniels, Four Buttes (8.5 mi. NE); 48.9252° N, 105.5363° W; elev. 774 m.; 31 Jul. 2020; Pritchard Z.A., Botti J. leg.; MTEC • 1♂; Dawson, Glendive; [47.1064° N, 104.7108° W]; 24 Aug. 1969; Michener C.D. leg.; SEMC • 1♀; Fergus, Buffalo; [46.8209° N, 109.8279° W]; 08 Jun. 1952; Michener C.D. leg.; ex *Ratibida* sp.; SEMC • 2♀♀; Gallatin, DCP?, Three Forks (5 mi. S); [45.8207° N, 111.5341° W]; 30 Jul. 1996; Seibert C.E. leg.; CESC • 2♂♂; same location as preceding; 16 Jul.

1996; Seibert C.E. leg.; CESC • 1♀; Gallatin, Gallatin County Botanical; 45.6605° N, 110.9475° W; 15 Aug. 2014; Delphia C.M., Monte J.L. leg.; MTEC • 1♀; Gallatin, Gallatin Grown; 45.7713° N, 111.2953° W; 22 Aug. 2013; Delphia C.M. leg.; ex *Helianthus maximiliani*; MTEC • 1♀; same location as preceding; 02 Aug. 2013; Delphia C.M. leg.; MTEC • 2♀♀; same location as preceding; 15 Aug. 2013; Delphia C.M. leg.; MTEC • 1♀; same location as preceding; 15 Aug. 2013; Delphia C.M. leg.; MTEC • 1♀; same location as preceding; 30 Aug. 2013; Delphia C.M. leg.; MTEC • 1♂; same location as preceding; 08 Jul. 2014; Delphia C.M. leg.; ex *Gaillardia aristata*; MTEC • 1♂; same location as preceding; 08 Aug. 2013; Delphia C.M. leg.; ex *Helianthus maximiliani*; MTEC • 2♀♀; same location as preceding; 16 Jul. 2015; Delphia C.M., Monte J.L. leg.; ex *Gaillardia aristata*; MTEC • 1♀; same location as preceding; 16 Jul. 2014; Delphia C.M. leg.; ex *Erigeron speciosus*; MTEC • 1♀; same location as preceding; 08 Jul. 2014; Delphia C.M. leg.; ex *Gaillardia aristata*; MTEC • 2♀♀; same location as preceding; 09 Jul. 2015; Delphia C.M., Monte J.L. leg.; MTEC • 2♀♀, 2♂♂; same location as preceding; 16 Jul. 2014; Delphia C.M. leg.; ex *Gaillardia aristata*; MTEC • 1♀; same location as preceding; 26 Aug. 2015; Delphia C.M., Monte J.L. leg.; MTEC • 1♂; same location as preceding; 16 Jul. 2015; Delphia C.M., Monte J.L. leg.; ex *Gaillardia aristata*; MTEC • 1♂; same location as preceding; 31 Jul. 2014; Delphia C.M., Monte J.L. leg.; MTEC • 1♀; same location as preceding; 30 Aug. 2013; Delphia C.M. leg.; MTEC • 1♀; same location as preceding; 02 Aug. 2013; Delphia C.M. leg.; MTEC • 1♀; same location as preceding; 09 Jul. 2015; Delphia C.M., Monte J.L. leg.; MTEC • 1♀; same location as preceding; 28 Aug. 2014; Delphia C.M., Monte J.L. leg.; MTEC • 2♀♀, 1♂; same location as preceding; 30 Jul. 2015; Delphia C.M., Monte J.L. leg.; ex *Helianthus maximiliani*; MTEC • 1♀, 1♂; same location as preceding; 23 Jul. 2014; Delphia C.M., Monte J.L. leg.; ex *Erigeron speciosus*; MTEC • 1♂;

same location as preceding; 30 Jul. 2015; Delphia C.M., Monte J.L. leg.; ex *Helianthus maximiliani*; MTEC • 1♀; same location as preceding; 07 Aug. 2015; Delphia C.M., Monte J.L. leg.; ex *Helianthus maximiliani*; MTEC • 2♀♀; same location as preceding; 01 Jul. 2015; Delphia C.M., Monte J.L. leg.; ex *Gaillardia aristata*; MTEC • 2♂♂; same location as preceding; 09 Jul. 2015; Delphia C.M., Monte J.L. leg.; ex *Gaillardia aristata*; MTEC • 3♂♂; same location as preceding; 24 Jul. 2015; Delphia C.M., Monte J.L. leg.; ex *Erigeron speciosus*; MTEC • 1♂; same location as preceding; 08 Jul. 2014; Delphia C.M. leg.; ex *Gaillardia aristata*; MTEC • 1♀; same location as preceding; 07 Aug. 2015; Delphia C.M., Monte J.L. leg.; MTEC • 1♀; same location as preceding; 08 Jul. 2014; Delphia C.M. leg.; ex *Gaillardia aristata*; MTEC • 1♀; same location as preceding; 05 Sep. 2014; Delphia C.M. leg.; ex *Helianthus maximiliani*; MTEC • 3♀♀, 7♂♂; same location as preceding; 16 Jul. 2015; Delphia C.M., Monte J.L. leg.; ex *Gaillardia aristata*; MTEC • 2♀♀, 2♂♂; same location as preceding; 16 Jul. 2015; Delphia C.M., Monte J.L. leg.; ex *Erigeron speciosus*; MTEC • 1♂; same location as preceding; 16 Jul. 2015; Delphia C.M. leg.; ex *Gaillardia aristata*; MTEC • 1♀; same location as preceding; 24 Jul. 2015; Delphia C.M., Monte J.L. leg.; MTEC • 1♀; same location as preceding; 16 Jul. 2015; Delphia C.M. leg.; ex *Erigeron speciosus*; MTEC • 4♀♀, 3♂♂; same location as preceding; 16 Jul. 2015; Delphia C.M. leg.; ex *Gaillardia aristata*; MTEC • 1♀; same location as preceding; 02 Aug. 2013; Delphia C.M. leg.; MTEC • 1♀; Gallatin, Townes Harvest Garden; [45.6643° N, 111.0721° W]; 16 Aug. 2010; Delphia C.M. leg.; MTEC • 1♀; same location as preceding; 08 Aug. 2011; Delphia C.M. leg.; MTEC • 1♀; same location as preceding; 03 Sep. 2010; Delphia C.M. leg.; MTEC • 1♂; Gallatin, Townes Harvest Garden; 45.6653° N, 111.0725° W; 07 Aug. 2013; Delphia C.M. leg.; MTEC • 1♀; same location as preceding; 31 Jul. 2013; Delphia C.M. leg.; MTEC • 1♀; same location as preceding; 25 Jul. 2014; Delphia C.M., Monte J.L. leg.;

MTEC • 2♀♀; same location as preceding; 31 Jul. 2013; Delphia C.M. leg.; MTEC • 3♀♀; same location as preceding; 15 Aug. 2013; Delphia C.M. leg.; MTEC • 1♀; same location as preceding; 01 Aug. 2014; Delphia C.M., Monte J.L. leg.; MTEC • 1♀; same location as preceding; 25 Jul. 2014; Delphia C.M., Monte J.L. leg.; MTEC • 1♀; same location as preceding; 10 Jul. 2015; Delphia C.M., Monte J.L. leg.; MTEC • 1♀; same location as preceding; 10 Jul. 2015; Delphia C.M., Monte J.L. leg.; ex *Gaillardia aristata*; MTEC • 1♂; same location as preceding; 27 Aug. 2014; Delphia C.M., Monte J.L. leg.; ex *Helianthus maximiliani*; MTEC • 1♀; Garfield, Jordan (22 mi. N), Highway 341; 47.688° N, 106.486° W; elev. 787 m.; 10 Jul. 2018; Kole J.P. leg.; MTEC • 1♂; Liberty, Joplin; [48.5609° N, 110.7725° W]; 13 Jun. 1951; Michener C.D., Fische B.L. leg.; ex *Echinacea angustifolia*; SEMC • 1♀; same location as preceding; 13 Jun. 1951; Michener C.D., Fische B.L. leg.; ex *Rudbeckia hirta*; SEMC • 1♀, 1♂; Madison, Red Bluff, Norris (2.5 km E NE); [45.5886° N, 111.6484° W]; 23 Jul. 1996; Seibert C.E. leg.; CESC • 2♀♀; Prairie, Terry (26 mi. NW), Big Sheep Mountain Road; 47.0358° N, 105.6647° W; elev. 970 m.; 11 Jul. 2018; Kole J.P. leg.; MTEC • 1♀; Prairie, Terry (32 mi. NW), Big Sheep Mountain Road; 47.0788° N, 105.7899° W; elev. 930 m.; 11 Jul. 2018; Kole J.P. leg.; MTEC • 1♂; Pryor Mountains, Gyp Springs Road; 45.0184° N, 108.4648° W; elev. 1499 m.; 05 Jul. 2018; Delphia C.M., Runyon J.B. leg.; MTEC • 1♂; Ravalli, Corvallis; [46.3141° N, 114.1129° W]; 16 Aug. 1926; MTEC • 1♀; Sweet Grass, Fish Creek (3 mi. S); [46.1671° N, 110.0382° W]; 17 Jun. 2006; Seibert C.E. leg.; CESC – **Nebraska** • 1♀; Arthur, Arapahoe Prairie; [41.4938° N, 101.8215° W]; 07 Jul. 1987; Rozen J.G. leg.; ex *Helianthus petiolaris*; AMNH • 1♀; Cherry, Nebraska National Forest; 41.9145° N, 100.5554° W; 15 Jun. 1965; LaBerge, Ribble leg.; ex *Oenothera*; INHS • 1♂; Cherry, Valentine; [42.8728° N, 100.551° W]; 10 Sep. 1951; Gilbert E.E. leg.; OSUC • 2♀♀; Cherry, Valentine (20 mi SE);

[42.6584° N, 100.2828° W]; 11 Aug. 1978; Michener C.D. leg.; ex *Helianthus petiolaris*; SEMC • 1♂; Custer, Oconto, Wide ravine (3 km NNE); 41.1656° N, 99.7485° W; 19 Aug. 2001; Irwin M.E., Hauser M. leg.; BBSL • 2♀♀, 1♂; Custer, Westerville; [41.3962° N, 99.3813° W]; 30 Jun. 1949; Vaurie P., Vaurie C. leg.; AMNH • 2♀♀; Hitchcock, Culbertson; [40.2307° N, 100.837° W]; 08 Aug. 1954; LaBerge W.E. leg.; ex *Helianthus petiolaris*; SEMC • 1♀; Morrill, Chimney Rock, Chimney Rock (1.5 km ESE); 41.6994° N, 103.3327° W; 27 Jul. 2012; Orr M.C. leg.; BBSL • 1♂; Sioux, Harrison (7 mi. N); [42.6872° N, 103.8827° W]; 13 Aug. 1962; Rozen J.G., Rozen B.L. leg.; ex *Helianthus* sp.; AMNH • 1♀; Sioux ; [42.5013° N, 103.7289° W]; CNC • 1♀; West Point; [41.84° N, 96.71° W]; 1903-09-12?; Crawford J.C. leg.; ex *Bidens*; SMIC – **New Mexico** • 3♀♀, 3♂♂; Bernalillo , Tijeras (5 mi. S); [35.0795° N, 106.3879° W]; elev. 2225 m.; 30 Jul. 1972; Eickwort G.C. leg.; CUIC • 1♀; Colfax, Cimmaron (20 mi. NE); [36.6716° N, 104.6092° W]; 14 Aug. 1971; Rozen J.G., Rozen B.L., Rozen K.C. leg.; AMNH • 1♀, 1♂; Colfax, Eagle Nest (3 mi. E); [36.5548° N, 105.2636° W]; 14 Aug. 1971; Rozen J.G., Rozen B.L., Rozen K.C. leg.; AMNH • 1♂; Colfax, Raton Pass; 36.9911° N, 104.4856° W; elev. 2377 m.; 05 Aug. 1933; Rodeck H.G., James M.T. leg.; UCMC • 1♂; Lincoln, Philadelphia Canyon, Bonito Lake (3.6 km E); 33.4519° N, 105.6942° W; 28 Jul. 2009; Griswold T.L. leg.; BBSL • 3♀♀; Lincoln, Ruidoso; 33.57° N, 105.6117° W; elev. 2100 m.; 29 Sep. 1999; Brooks R.W., Michener C.D. leg.; ex *Heliomeris multiflora* var. *nevadensis*; SEMC • 1♂; Pecos; [35.5778° N, 105.6974° W]; Aug. 1912; Cockerell W.P. leg.; CAS • 1♀; San Miguel, Beulah; 35.364° N, 105.45° W; July; Cockerell T.D.A. leg.; CNC • 1♂; same location as preceding; 1899-08-25; Porter W. leg.; CAS • 1♀, 1♂; San Miguel, Beulah; [35.364° N, 105.45° W]; 29 Jun. 1902; UKIC • 1♀; Sandoval, Jemez Springs; [35.7686° N, 106.6923° W]; elev. 1951 m.; 10 Apr. 1916; Woodgate J.M. leg.; CUIC • 2♂♂; same location as preceding; 24 Nov. 1916; Woodgate J.M.

leg.; CUIC • 1♂; same location as preceding; 22 Jul. 1950; Arnold W.J. leg.; SEMC • 1♂; same location as preceding; 27 Apr. 1916; Woodgate J. leg.; CUIC • 1♂; same location as preceding; 17 Apr. 1916; Woodgate J. leg.; CUIC • 1♂; Socorro, Cibola National Forest, South Baldy Meadow; [33.9911° N, 107.1878° W]; 27 Aug. 2018; ex *Erigeron formosissimus*; OSAC: LP • 1♂; Taos, Arroyo Hondo, Arroyo Hondo Bridge on Rio Grande (1 mi. N); [36.5508° N, 105.7143° W]; 27 Jul. 1974; Blake B. leg.; TAMUIC • 3♂♂; Torrance, Cibola National Forest, New Canyon Campground; [34.6809° N, 106.398° W]; elev. 2377 m.; 30 Jul. 1972; Eickwort G.C. leg.; CUIC • 1♀; Union, Clayton Lake (7 mi. N); 36.63° N, 103.3067° W; elev. 1646 m.; 19 Sep. 1999; Hicks A.L., Scott V. leg.; UCMC • 1♂; Valencia, Los Lunas, Carrizo Arroyo (20 mi. W); [34.8085° N, 106.83° W]; 01 Aug. 1977; Peck S., Peck J. leg.; PMAE – **North Carolina** • 1♀, 1♂; Buncombe, Black Mountain; [35.6179° N, 82.3212° W]; 09 Jul. 1906; Beutenmuller W. leg.; AMNH • 1♂; same location as preceding; 21 Jul. 1906; Beutenmuller W. leg.; AMNH • 2♂♂; same location as preceding; 09 Jul. 1906; Beutenmuller W. leg.; AMNH • 1♀, 1♂; Buncombe, Swannanoa; [35.5979° N, 82.3998° W]; 21 Jul. 1924; Mitchell T.B. leg.; CNC • 1♀; Macon, Nantahala National Forest, Wayah Bald; [35.1804° N, 83.5779° W]; 29 Jul. 1957; Richards W.R. leg.; CNC – **North Dakota** • 2♂♂; Barnes, Lucca; [46.7069° N, 97.7198° W]; 16 Jul. 1913; Stevens O.A. leg.; ex *Ratibida pinnata*; AMNH • 1♂; Barnes, Rogers (3.3 km NNE); 47.1031° N, 98.1933° W; 07 Sep. 2011; Evans E. leg.; MNDNR • 1♂; Barnes, Valley City; [46.9233° N, 98.0032° W]; 29 Jun. 1913; Stevens O.A. leg.; ex *Gaillardia aristata*; AMNH • 1♂; same location as preceding; 13 Aug. 1912; Stevens O.A. leg.; ex *Helianthus scaberrimus*; AMNH • 1♀; same location as preceding; 22 Jul. 1915; Stevens O.A. leg.; ex *Ratibida pinnata*; AMNH • 1♀; same location as preceding; 26 Jul. 1911; Stevens O.A. leg.; ex *Centaurea jacea*; AMNH • 1♀, 1♂; same location as preceding; 27 Jul. 1915; Stevens O.A. leg.; ex *Echinacea*

pallida; AMNH • 1♀, 2♂♂; Cass, Fargo; [46.8772° N, 96.7898° W]; 26 Jul. 1911; Stevens O.A. leg.; ex *Helianthus annuus*; AMNH • 1♂; same location as preceding; 12 Aug. 1912; Stevens O.A. leg.; ex *Helianthus maximiliani*; AMNH • 1♂; same location as preceding; 02 Aug. 1913; Stevens O.A. leg.; ex *Helianthus annuus*; AMNH • 1♀, 1♂; McLean, Washburn; [47.2892° N, 101.029° W]; 23 Jul. 1926; Stevens O.A. leg.; ex *Helianthus petiolaris*; AMNH • 1♀, 1♂; Montrail, Stanley; [48.3172° N, 102.3905° W]; 15 Aug. 1915; Stevens O.A. leg.; CUIC • 1♀, 1♂; Mountrail, Stanley; [48.3172° N, 102.3905° W]; 15 Aug. 1915; Stevens O.A. leg.; ex *Helianthus hirsutus*; AMNH • 1♀, 1♂; Nelson, Lakota; [48.0428° N, 98.3362° W]; 05 Sep. 1913; Stevens O.A. leg.; ex *Helianthus maximiliani*; AMNH • 1♂; Sargent, Nicholson; [46.1091° N, 97.8682° W]; 04 Jul. 1913; Stevens O.A. leg.; ex *Oenothera serrulata*; AMNH • 2♀♀, 1♂; same location as preceding; 04 Jul. 1913; Stevens O.A. leg.; ex *Ratibida pinnata*; AMNH • 1♂; same location as preceding; 23 Jul. 1913; Stevens O.A. leg.; ex *Ratibida pinnata*; UKIC • 1♂; Slope, Burning Coal Vein; [46.5978° N, 103.4462° W]; 14 Aug. 1975; Lago P.K., Lago B.A. leg.; MEM • 2♀♀, 1♂; Slope, Marmarth; [46.295° N, 103.9208° W]; 04 Jul. 1918; Stevens O.A. leg.; ex *Echinacea pallida*; AMNH • 1♀; Stutsman, Edmunds (2.4 km E); 47.2423° N, 98.933° W; 14 Aug. 2012; Evans E. leg.; MNDNR • 2♀♀, 2♂♂; Ward, Minot; [48.233° N, 101.2923° W]; 25 Jul. 1915; Stevens O.A. leg.; ex *Echinacea pallida*; AMNH • 1♀, 1♂; same location as preceding; 25 Jul. 1915; Stevens O.A. leg.; ex *Ratibida pinnata*; AMNH • 9♀♀, 4♂♂; Grand Forks, Mekinock Field Station; [47.9622° N, 97.452° W]; elev. 280 m.; 15 Jul. 2015; Swartz S. leg.; ex *Ratibida pinnata*; NDSU • 4♀♀, 2♂♂; same location as preceding; 21 Jul. 2015; Park M. leg.; NDSU • 2♀♀, 2♂♂; same location as preceding; 14 Jul. 2015; Devine R. leg.; ex *Ratibida pinnata*; NDSU • 1♀; same location as preceding; 14 Jul. 2015; Park M. leg.; ex *Ratibida pinnata*; NDSU • 6♀♀, 3♂♂; same location as preceding; 15 Jul. 2015; Park M.

leg.; ex *Ratibida pinnata*; NDSU • 2♀♀, 1♂; same location as preceding; 20 Jul. 2015; Park M. leg.; ex *Ratibida pinnata*; NDSU – **Oklahoma** • 11♂♂; Blaine, Watonga, Roman Nose State Park; [35.9363° N, 98.4251° W]; 17 May. 1977; Michener C.D. leg.; ex *Gaillardia* sp.; SEMC • 1♀; Cimmaron, Boise City, Cimmaron River; [36.7295° N, 102.5132° W]; 07 Jul. 1978; Bohart G.E. leg.; ex *Grindelia*; UCMC • 1♀; Cleveland, Norman, Saxon Park; [35.184° N, 97.3891° W]; 04 Oct. 2021; Hung K.L.J. leg.; ex *Helianthus maximiliani*; OMNH: JH • 1♀, 2♂♂; Cleveland, Norman, University of Oklahoma; [35.1924° N, 97.4496° W]; 18 Oct. 2021; Hung K.L.J. leg.; ex *Helianthus maximiliani*; OMNH: JH • 2♀♀, 2♂♂; Ellis, Four Canyon Preserve, T18 R22 Sec 24 (N1/2); [36.025° N, 99.494° W]; 08 Jun. 2009; Jean R.P. leg.; ex *Engelmannia peristenia*; RJPC • 9♀♀, 6♂♂; Kiowa, Lone Wolf (7 mi SW); [34.9089° N, 99.3225° W]; 03 Jun. 1979; Michener C.D. leg.; ex *Thelesperma filifolium*; SEMC • 4♂♂; Kiowa, Lone Wolf (7 mi. SW); [34.9895° N, 99.2495° W]; 03 Jun. 1979; Michener C.D. leg.; ex *Engelmannia pinnatifida*; SEMC • 9♂♂; Murray, Arbuckle, U.S. hwy 77; [34.432° N, 97.1909° W]; 04 Jun. 1975; Michener C.D. leg.; ex *Engelmannia pinnatifida*; SEMC – **South Dakota** • 2♂♂; Custer, Black Hills National Forest, Jewel Cave (3 mi. W); 43.7253° N, 103.8755° W; elev. 1646 m.; 06 Sep. 1999; Hicks A.L., Scott V. leg.; ex *Rudbeckia*; UCMC • 1♂; Custer, FS Rd 282; 43.805° N, 103.8322° W; 12 Sep. 2011; Drons D. leg.; SMIC • 1♀; Custer, FS Rd 287; 43.7629° N, 103.7307° W; 13 Sep. 2011; Drons D. leg.; ex *Grindelia squarrosa*; SMIC • 2♀♀, 2♂♂; Custer, Hwy 79/Lame John Rd.; 43.6077° N, 103.3003° W; 04 Sep. 2011; Drons D. leg.; ex *Helianthus*; SMIC • 2♀♀; Fall River, Hot Springs, Battle Mountain; 43.4449° N, 103.4533° W; 04 Aug. 2011; Drons D. leg.; ex *Helianthus*; SMIC • 1♂; Fall River, TNC Whitney Preserve; 43.3404° N, 103.5558° W; 05 Aug. 2011; Drons D. leg.; SMIC • 1♀; Penn, Custer (2 mi. N), Oreville Camp; [43.8781° N, 103.6141° W]; 08 Jul. 1977; Peck S. leg.; PMAE • 3♂♂; Pennington, Badlands

National Monument (Park); [43.8° N, 102.4° W]; 26 Jun. 1972; Wolf S. leg.; WIRC • 1♂; same location as preceding; 24 Jun. 1972; Wolf S. leg.; WIRC • 1♀; Pennington, Keystone; [43.8955° N, 103.4182° W]; 16 Jul. 1937; Johnston C.L. leg.; SEMC • 1♀; Pennington; [43.8521° N, 102.1753° W]; 17 Jul. 2012; BIML • 2♂♂; Pennington; [43.6793° N, 102.5705° W]; 17 Aug. 2011; BIML • 2♂♂; Pennington; [43.9069° N, 102.4195° W]; 21 Jun. 2012; Droege S.W. leg.; BIML • ♂; Pennington; [43.7577° N, 102.5079° W]; 20 Sep. 2011; BIML • 2♀♀; Washbaugh, Long Valley; [43.4632° N, 101.4957° W]; 11 Aug. 1978; Michener C.D. leg.; ex *Helianthus annuus*; SEMC • 1♂; Agar; [44.84° N, 100.07° W]; 07 Jul. 1944; Severin H.C. leg.; SMIC • 1♂; Custer; [43.77° N, 103.6° W]; 18 Jul. 1924; SMIC • 1♂; Gettesburg; [45.01° N, 99.96° W]; 07 Jul. 1944; Severin H.C. leg.; SMIC • 1♂; Interior; [43.73° N, 101.98° W]; 05 Aug. 1924; SMIC • 1♀; Orman Dam; 29 Jul. 1924; SMIC • 1♂; Phillip; [44.04° N, 101.67° W]; 07 Aug. 1924; SMIC • 1♂; Rapid Canyon; 04 Aug. 1924; SMIC • 3♂♂; Redig; [45.27° N, 103.55° W]; 30 Jul. 1924; SMIC • 1♂; Slim Butte; [43.08° N, 102.82° W]; 31 Jul. 1924; SMIC – **Texas** • 1♂; Bexar, San Antonio; [29.4241° N, 98.4936° W]; 04 May. 1905; Crawford J.C. leg.; ex *Coreopsis tinctoria*; AMNH • 1♂; Bexar, San Antonio, Green Mountain Road; [29.6025° N, 98.3679° W]; 20 May. 1995; Pollock D.M. leg.; MEM • 1♀; Blanco, Pedernales Falls State Park; 30.332° N, 98.256° W; 11 Apr. 2019; Neff J.L. leg.; ex *Amblyolepis setigera*; CTMI • 1♀; Bosque; [31.8508° N, 97.6982° W]; 1872; Belfrage G.W. leg.; ANSP • 1♀; Callahan, Baird (10 mi S); [32.2575° N, 99.4014° W]; 27 May. 1978; Michener C.D. leg.; ex *Engelmannia pinnatifida*; SEMC • 1♂; Callahan, Baird (10 mi. S); [32.394° N, 99.3942° W]; 28 May. 1978; Michener C.D. leg.; ex *Engelmannia pinnatifida*; SEMC • 1♂; Collin, Allen; [33.1032° N, 96.6706° W]; 28 May. 1978; Weaver J.K. leg.; TAMUIC • 2♀♀, 1♂; Comal, New Braunfels (15 mi NW); [29.8235° N, 98.2951° W]; 01 Jun. 1975; Michener et al leg.; ex *Coreopsis* sp.; SEMC • 1♀, 1♂;

Comal; [29.8106° N, 98.2213° W]; 19 May. 1948; Knull D.J., J.N. leg.; OSUC • 1♂; Erath, Bluff Dale, Paluxy River (1 mi. N); [32.3859° N, 98.0254° W]; 28 Apr. 1978; Sams R.L leg.; TAMUIC • 2♂♂; same location as preceding; 21 Apr. 1978; Sams R.L leg.; TAMUIC • 1♂; same location as preceding; 19 May. 1978; Sams R.L leg.; TAMUIC • 1♂; Frio, Pearsall (2 mi. N); [28.9269° N, 99.0971° W]; 08 May. 1976; Schaffner J.C. leg.; TAMUIC • 3♂♂; Gillespie; [30.315° N, 98.9245° W]; 07 May. 1946; Knull D.J., J.N. leg.; OSUC • 1♂; same location as preceding; 06 May. 1946; Knull D.J., J.N. leg.; OSUC • 1♂; Guadaliupe, Seguin, R123 (12 mi. S); 29.406° N, 97.855° W; 03 May. 2014; Neff J.L. leg.; ex *Engelmannia peristenia*; CTMI • 1♂; Hays, Wimberley (5 mi. NW); [30.0301° N, 98.1704° W]; 25 Apr. 1982; Schaffner J.C. leg.; TAMUIC • 1♂; Kerr, Hunt; [30.071° N, 99.338° W]; 06 May. 1966; Schaffner J.C. leg.; TAMUIC • 2♂♂; Kerr, Kerrville; [30.0474° N, 99.1403° W]; 22 Jun. 1942; Ross E.S. leg.; CAS • 1♂; same location as preceding; 24 May. 1993; Vockeroth J.R. leg.; CNC • 1♂; same location as preceding; 15 May. 1965; Chamberlain W.F. leg.; TAMUIC • 2♂♂; Kimble, Junction; [30.4894° N, 99.772° W]; 05 May. 1986; Pulawski W.J. leg.; CAS • 1♂; same location as preceding; 24 Apr. 1986; Pulawski W.J. leg.; CAS • 1♂; same location as preceding; 06 May. 1986; Pulawski W.J. leg.; CAS • 1♂; same location as preceding; 04 May. 1986; Pulawski W.J. leg.; CAS • 1♂; Mason, Mason; [30.7488° N, 99.2306° W]; 23 Apr. 1979; Burke H., Delorme D., Schaffner J.C. leg.; TAMUIC • 4♀♀, 2♂♂; San Saba, Colorado State Park, Conference Center; 31.0575° N, 98.4814° W; 22 Sep. 2016; Buck M. leg.; PMAE • 1♀, 2♂♂; San Saba, Colorado State Park, Park HQ; 31.0236° N, 98.4414° W; 21 Sep. 2016; Buck M. leg.; PMAE • 1♂; Somervell, Glen Rose; [32.2346° N, 97.7553° W]; 19 May. 1940; Knutson H. leg.; UMSP • 1♂; Terrell, Sanderson; [30.1424° N, 102.394° W]; 14 Sep. 1970; Baker. Kamm. Michener. leg.; SEMC • 1♂; Throckmorton, Throckmorton (13 mi. S); [33.1787° N, 99.1776° W]; 27 Aug.

1978; Michener C.D. leg.; ex *Ratibida* sp.; SEMC • 1♂; Travis, Austin; [30.2672° N, 97.7431° W]; 28 Sep. 1975; Henderson B. leg.; TAMUIC • 1♀, 1♂; Travis, Austin (8 mi. NNW); [30.3934° N, 97.671° W]; 10 May. 1969; Vogel B., Vogel M. leg.; UCMC • 10♂♂; Uvalde, Uvalde (10 km W); [29.2048° N, 99.8909° W]; 29 Apr. 1989; Sugden E.A. leg.; BBSL • 1♂; Uvalde, Sabinal (7 mi. N); [29.4188° N, 99.4685° W]; 01 May. 1983; Schaffner J.C. leg.; TAMUIC • 1♂; Uvalde, Uvalde (5 mi N); [29.2097° N, 99.7862° W]; 23 May. 1969; Brothers, Krueger, Michener leg.; SEMC • 1♂; Uvalde; [29.3343° N, 99.8125° W]; 13 Jun. 1949; Knull D.J., J.N. leg.; OSUC • 1♀; Val Verde, Blue Sage Crossing; 29.782° N, 100.993° W; 27 Apr. 2019; Neff J.L. leg.; ex *Ratibida pinnata*; CTMI • 1♂; Val Verde, Dolan Falls; [29.8844° N, 100.9934° W]; 27 Apr. 2001; Neff J.L. leg.; CTMI • 1♀; Val Verde; [29.8688° N, 101.1617° W]; 13 May. 1946; Knull D.J., J.N. leg.; OSUC • 28♀♀, 24♂♂; Wilbarger, Vernon (15 mi. N); [34.1545° N, 99.2651° W]; 27 May. 1978; Michener C.D. leg.; ex *Engelmannia pinnatifida*; SEMC • 1♂; Wilbarger, Vernon (17 mi. N); [34.4063° N, 99.3338° W]; 02 Jun. 1979; Michener C.D. leg.; SEMC – **Utah** • 2♂♂; Beaver, Beaver (16 mi. E); [38.2769° N, 112.6411° W]; elev. 2682 m.; 16 Jul. 1960; Rindge F., Rindge P., Rindge B. leg.; AMNH • 1♀; Wayne, Henry Mountains, Hanksville (24 mi. S); [38.1089° N, 110.8312° W]; elev. 2286 m.; 30 Jul. 1968; Martin J.E.H. leg.; CNC – **Virginia** • 1♀; Grayson, Highlands State Park; [36.6141° N, 81.481° W]; 10 Aug. 2016; Orcutt E.C. leg.; BIML • 1♀; Rappahanock, Jones Nature Preserve; [38.6892° N, 78.1323° W]; 30 Jun. 2014; Kula R.R. et al. leg.; BIML – **Wisconsin** • 1♀; Burnett, Kettle River Rapids; [45.9389° N, 92.7678° W]; 04 Aug. 1909; UKIC • 1♂; Burnett, Yellow River; [44.3531° N, 90.1219° W]; 01 Aug. 1909; Miller R. leg.; ex *Helianthus*; UKIC • 1♀; Oconto, Lakewood, Chequamegon-Nicolet National Forest; 45.3298° N, 88.325° W; elev. 301 m.; 16 Jul. 2019; USFS Staff leg.; RMNH – **Wyoming** • 1♂; Johnson, Buffalo, Clear Creek;

[44.3375° N, 106.7693° W]; 08 Jul. 1959; Beneway D.F. leg.; SEMC • 1♂; Niobrara; [43.0547° N, 105.0367° W]; 10 Jul. 1943; Pfadt R.E. leg.; ESUW • 1♀; Platte, Chugwater; [41.7566° N, 104.8216° W]; 10 Aug. 1951; Pfadt R.E. leg.; ESUW • 2♀♀, 4♂♂; Platte, Wheatland (20 mi N); [42.339° N, 105.051° W]; 24 Jun. 1966; Pfadt R.E. leg.; ESUW • 1♂; Sheridan, Sheridan; [44.7972° N, 106.9562° W]; 10 Jul. 1949; Pfadt R.E. leg.; ex *Helianthus annuus*; ESUW – • 1♂; Goodview; 18 Jul.; ex *Helianthus annuus*; CNC

Description.

Male:

Structure: Body length range 5.61–7.16 mm. Head broader than long (HL/HW ratio 0.86). Face below antennae convex. Labral process trapezoidal, broader than long, apex emarginate. Clypeus without median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.28). Posterior ocelli 0.35 mm apart. Flagellomeres broader than long. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.37 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.15 mm. S6 notch deep, extending approximately 1/2 of disk, lateral carina present.

Sculpture: Clypeus punctation fine and sparse (IS > 1 PD). Paraocular punctation coarse and sparse (IS > 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea ovate. Foveae converging above, narrow end terminating 0.5 MOD from dorsal tangent of antennal socket. Frons coarsely reticulate. Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation coarse and sparse (IS = 1 – 2 PD). Scutellum punctation coarse and sparse (IS = 1 PD) denser medially (IS < 1 PD). Mesopleuron punctation coarse and dense (IS < 1 PD). Lateral propodeum finely reticulate. Posterior propodeum rugose. Posterior propodeum not

microsculptured. Dorsal face of T1 punctation fine and sparse medially (IS > 1 PD) denser laterally (IS < 1 PD). T2 basal impression deep, basal 1/2 of T2 lineolate. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus yellow with two black dots. Supraclypeal area black. Lower paraocular area yellow extending along margin of compound eye to within 1 MOD of antennal socket. Labral process black. Mandible black. Scape black. Flagellomeres dark. Pronotal lobe black. Tegula light brown. Wing veins and stigma light brown, membrane hyaline. Fore tibia narrowly yellow anteriorly, mid and hind tibia with yellow spot at knee. Tarsi dark brown.

Pubescence: Mesoscutum pilosity long, white. Scutellum pilosity very long, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence short, sparse. S4 pubescence short, sparse. S5 pubescence short, sparse.

Female:

Structure: Body length range 6.13–7.55 mm. Head broader than long (HL/HW ratio 0.84). Face below antennae convex. Labral process anchor shaped, longer than broad, apex truncate. Clypeus without median impressed line. Compound eyes convergent below (UOD/LOD ratio 1.12). Posterior ocelli 0.41 mm apart. Flagellomeres broader than long. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.57 mm. Metapostnotum weakly extended medially <25% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.085 mm.

Sculpture: Clypeus punctation coarse and sparse medially (IS = 1 – 2 PD), denser laterally (IS < 1 PD). Paraocular punctation coarse and sparse (IS = 1 - 1.5 PD). Supraclypeal area punctation coarse and sparse medially (IS > 1 PD), denser laterally (IS = 1 PD). Fovea ovate. Foveae

converging above, terminating two thirds antennal socket width from dorsal tangent. Frons punctation coarse and dense (IS < 1 PD). Vertex punctation coarse and sparse (IS = 1 PD). Mesoscutum punctation fine and sparse (IS = 1 – 2 PD). Scutellum punctation fine and sparse (IS > 4 PD) denser medially (IS < 0.5 PD). Mesopleuron punctation coarse and sparse (IS > 1 PD) denser dorsally (IS < 1 PD). Lateral propodeum punctation reticulate. Posterior propodeum punctation fine and dense (IS < 1 PD). Posterior propodeum tessellate. Dorsal face of T1 punctation fine and dense laterally (IS < 1 PD) sparser medially (IS > 2 PD). T2 basal impression absent, basal 1/3 of T2 imbricate. T3 punctation dense (IS < 1 PD). T4 punctation sparse (IS = 1 PD).

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F4-F10 orange ventrally. Pronotal lobe black. Tegula yellow. Wing veins yellow, stigma light brown, subcosta dark brown. Fore and mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi yellow.

Pubescence: Mesoscutum pilosity medium-length, white. Scutellum pilosity very long, white. Mesopleuron pilosity long, white. Sternite pubescence colour yellow. S3 pubescence medium length, sparse. S4 pubescence medium length, sparse. S5 pubescence medium-length, and sparse.

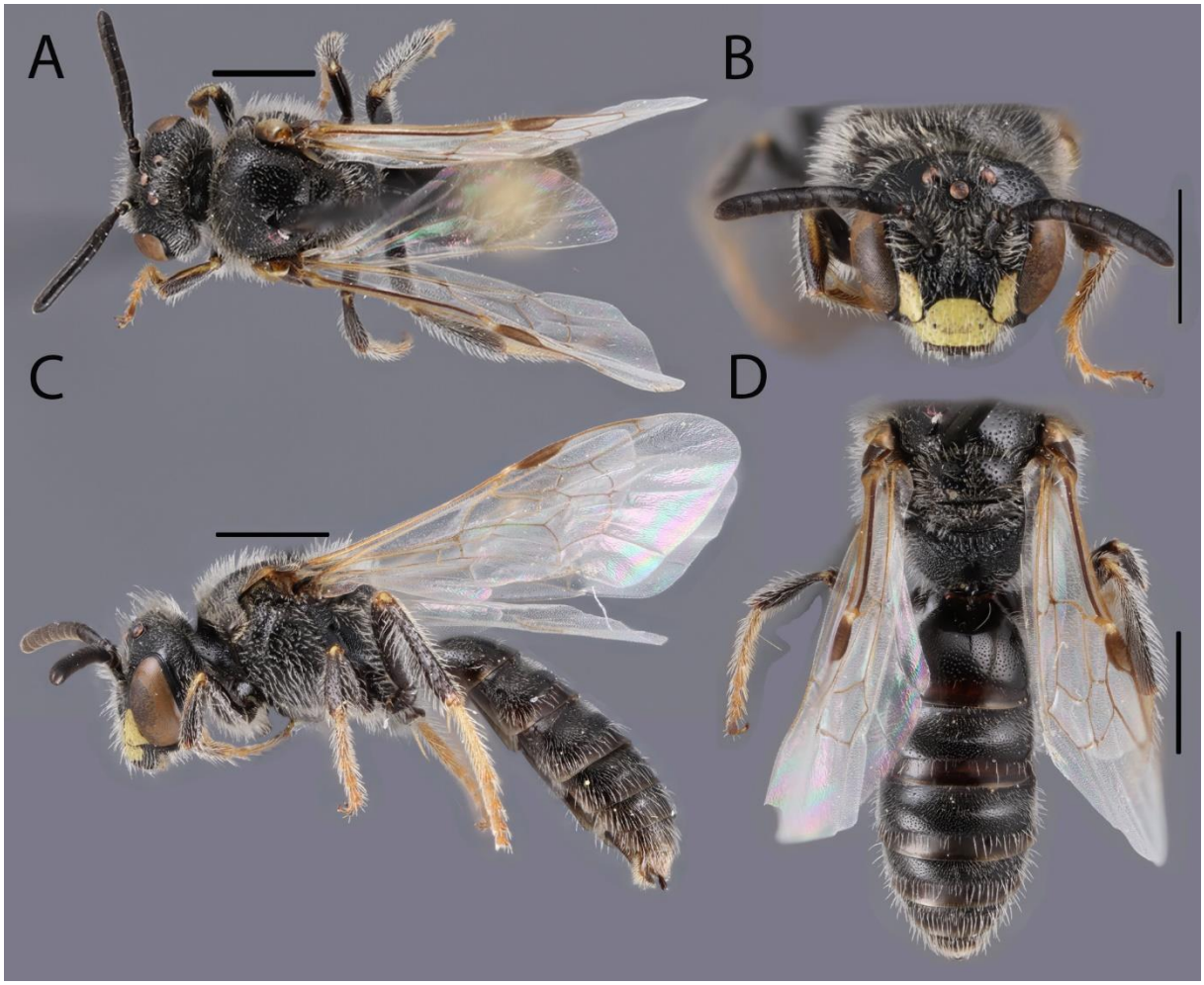


Figure 16. Protandrena (*Pterosarus*) *albitarsis*, ♂. UCMC_131682. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

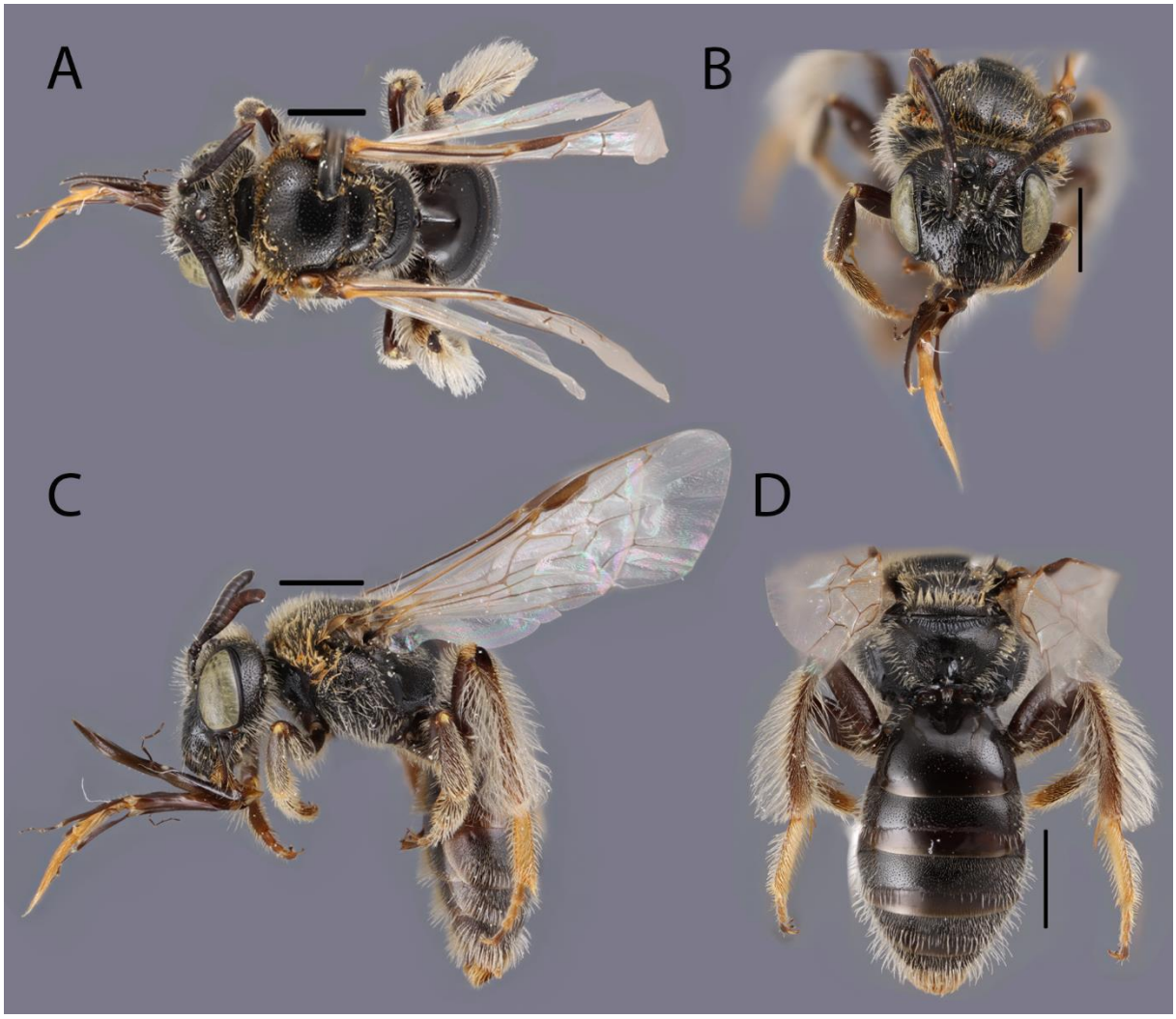


Figure 17. *Protandrena* (*Pterosarus*) *albitarsis*, ♀. RSKM_111343. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena albitarsis* has a broad flight period when considered across its geographical range, active from late April to late November. Rozen (1951) described and illustrated the genitalia of the male (as *Ps. innuptus*), remarking on the “very small” gonocoxal apodeme. Pierce (1918) recorded *Crawfordia pulvinipes* (Pierce 1904) (Strepsiptera: Stylopidae) as a parasite (as *Pa. innuptus*). Males sometimes vary in the degree of yellow on the face, but

maculations typically follow the same format of clypeus, paraocular marks and occasional supraclypeal spot. I have seen one male specimen that has had yellow restricted entirely to clypeus as in *Protandrena californica*, but it still possessed the notable two black dots indicative of *Protandrena albitarsis*. Most floral records come from plants in the tribe Heliantheae, primarily on *Helianthus*.

Range: Canada (Alberta, Manitoba, Saskatchewan), Mexico (Coahuila, Hidalgo, Nuevo Leon, Sonora), USA (Arizona, Arkansas, Colorado, Illinois, Kansas, Michigan, Minnesota, Missouri, Montana, Nebraska, New Mexico, North Carolina, North Dakota, Oklahoma, South Dakota, Texas, Utah, Virginia, Wisconsin, Wyoming).

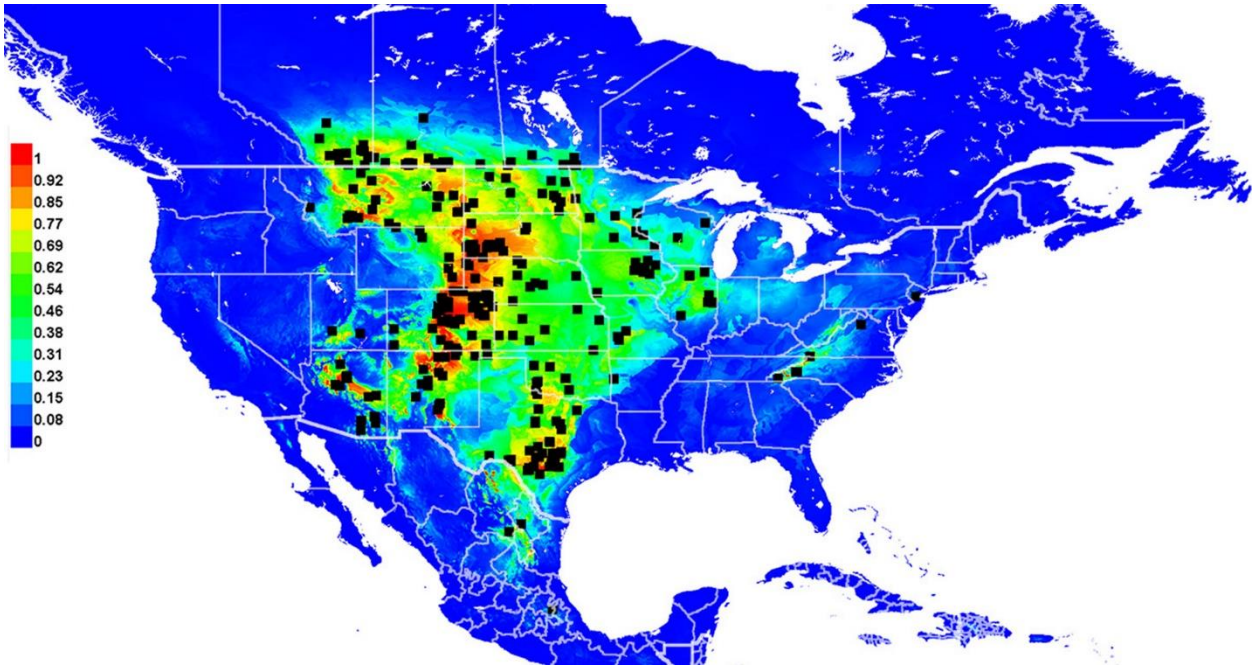


Figure 18. Georeferenced collection records of *Protandrena* (*Pterosarus*) *albitarsis* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *alveus* new species**

(Figure 19, Figure 20)

Holotype: ♀ Brazos; [30.6521° N, 96.6211° W]; 19 Oct. 1962; Alex A.H. leg.; ex *Croptilon divaricatum*; TAMUIC. TAMU-ENTO X1329294

Etymology:

The specific epithet alveus comes from the name of the Alveus animal sanctuary located in Texas USA.

Diagnosis:

Males of *Pr*. (*Pt*.) *alveus* can be recognized by a combination of their rugose posterior face of propodeum (contrast all except: *Pr. aestivalis, Pr. albertensis, Pr. albitarsis, Pr. andrenoides, Pr. californica, Pr. chepesepe, Pr. citripes, Pr. compositarum, Pr. leucoptera, Pr. piercei, Pr. rudbeckiae, Pr. skeggox, Pr. solidaginis, Pr. vicina, Pr. vigvierae*), scutum punctures that are reticulate anteriorly but fine and dense posteriorly (IS < 1 PD) (contrast *Pr. albertensis, Pr. albitarsis, Pr. californica, Pr. chepesepe, Pr. citripes, Pr. compositarum, Pr. leucoptera, Pr. piercei, Pr. rudbeckiae, Pr. skeggox, Pr. solidaginis, Pr. vicina, Pr. vigvierae*) and posterior face of propodeum with a dorsal non-macrosculptured area (contrast remaining).

Females of *Pr*. (*Pt*.) *alveus* can be recognized by their finely densely punctate posterior face of propodeum (IS < 1 PD) (contrast all except: *Pr. aestivalis, Pr. albitarsis, Pr. atricornis, Pr. labrosiformis, Pr. leucoptera, Pr. luxsolaris, Pr. nudescens, Pr. ornatipes, Pr. subtilis, Pr. vigvierae*), yellow pronotal lobes (contrast *Pr. aestivalis, Pr. albitarsis, Pr. atricornis*

labrosiformis, Pr. leucoptera, Pr. luxsolaris, Pr. nudescens, Pr. subtilis, Pr. vigvierae) and scutum reticulate anteriorly (contrast *Pr. ornatipes*)

Material examined:

USA – Texas • 1♂; Brazos, Junction of Turk Ranch Road with Duck Pond road (0.9 mi. SE); [30.601° N, 96.2146° W]; 18 Sep. 1976; Merritt S.J. leg.; TAMUIC • 3♀♀; Brazos; [30.6521° N, 96.6211° W]; 03 Oct. 1962; Alex A.H. leg.; ex *Croptilon divaricatum*; TAMUIC • 2♀♀; same location as preceding; 05 Oct. 1962; Alex A.H. leg.; ex *Heterotheca subaxillaris*; TAMUIC • 2♀♀; same location as preceding; 12 Oct. 1962; Alex A.H. leg.; ex *Heterotheca subaxillaris*; TAMUIC • 1♀; same location as preceding; 23 Oct. 1962; Alex A.H. leg.; ex *Heterotheca subaxillaris*; TAMUIC • 5♀♀; same location as preceding; 15 Oct. 1962; Alex A.H. leg.; ex *Heterotheca subaxillaris*; TAMUIC • 1♀; same location as preceding; 15 Oct. 1962; Alex A.H. leg.; ex *Croptilon divaricatum*; TAMUIC • 5♀♀; same location as preceding; 19 Oct. 1962; Alex A.H. leg.; ex *Croptilon divaricatum*; TAMUIC

Description

Male:

Structure: Body length 5.03 mm. Head broader than long (HL/HW ratio 0.87). Face below antennae convex. Labral process trapezoidal, broader than long, apex emarginate. Clypeus without median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.26). Posterior ocelli 0.22 mm apart. Flagellomeres broader than long. Dorsal pronotal carina absent. Prosternum not produced. ITD 0.94 mm. Metapostnotum extended medially 25%–50%

way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.125 mm. S6 notch deep, extending approximately 1/2 of disk, lateral carina absent.

Sculpture: Clypeus punctation fine and sparse (IS = 1 PD). Paraocular punctation fine and dense (IS < 1 PD). Supraclypeal area punctation fine and sparse (IS = 1 PD). Fovea ovate. Foveae converging above, narrow end terminating 0.5 MOD from dorsal tangent of antennal socket. Frons finely reticulate. Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation finely reticulate anteriorly sparser posteriorly (IS < 1 PD). Scutellum punctation coarse and dense laterally (IS < 1 PD) coarsely reticulate medially. Mesopleuron punctation coarse and dense (IS < 1 PD). Lateral propodeum finely reticulate. Posterior propodeum rugose. Posterior propodeum tessellate. Dorsal face of T1 punctation fine and dense (IS < 1 PD). T2 basal impression deep, approximately 1/2 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus yellow. Supraclypeal area yellow to within 1 MOD of antennal socket. Lower paraocular area yellow to within 0.5 MOD of ventral tangent of antennal socket medially, extending along margin of compound eye terminating in line with dorsal tangent of antennal socket. Labral process yellow. Mandible yellow. Scape yellow anteriorly. Flagellomeres F2-F9 yellow ventrally. Pronotal lobe yellow. Tegula brown. Wing veins and stigma brown, membrane brown. Fore tibia yellow anteriorly dark posteriorly, mid and hind tibia with reduced dark spot medially, yellow posteriorly. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, yellow/brown. Scutellum pilosity medium-length, white. Mesopleuron pilosity medium-length, white. Sternite pubescence colour white. S3 pubescence

medium-length, dense. S4 pubescence medium-length, dense. S5 pubescence long, medially directed apicolateral fringes.

Female:

Structure: Body length range 5.6–6.63 mm. Head broader than long (HL/HW ratio 0.87). Face below antennae convex. Labral process quadrate, broader than long, apex truncate. Clypeus without median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.09). Posterior ocelli 0.27 mm apart. Flagellomeres broader than long. Dorsal pronotal carina extends laterally to pronotal lobes. Prosternum not produced. ITD 1.2 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.12 mm.

Sculpture: Clypeus punctation fine and dense (IS < 1 PD). Paraocular punctation fine and dense (IS < 1 PD). Supraclypeal area punctation fine and dense (IS < 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 1/2 way down antennal socket. Frons finely reticulate. Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation finely reticulate anteriorly sparser posteriorly (IS < 1 PD). Scutellum punctation fine and dense laterally (IS < 1 PD) finely reticulate medially. Mesopleuron punctation fine and dense (IS < 1 PD). Lateral propodeum punctation fine and dense (IS < 1 PD). Posterior propodeum punctation fine and dense (IS < 1 PD). Posterior propodeum tessellate. Dorsal face of T1 punctation fine and sparse (IS = 1 PD) impunctate medially. T2 basal impression shallow, approximately 1/3 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation absent.

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F4-F10 yellow ventrally. Pronotal lobe

yellow. Tegula brown. Wing veins and stigma brown, membrane light brown. Fore and mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, yellow/brown. Scutellum pilosity short, yellow/brown. Mesopleuron pilosity medium-length, white. Sternite pubescence colour yellow/brown. S3 pubescence short, sparse. S4 pubescence short, sparse. S5 pubescence short, sparse.

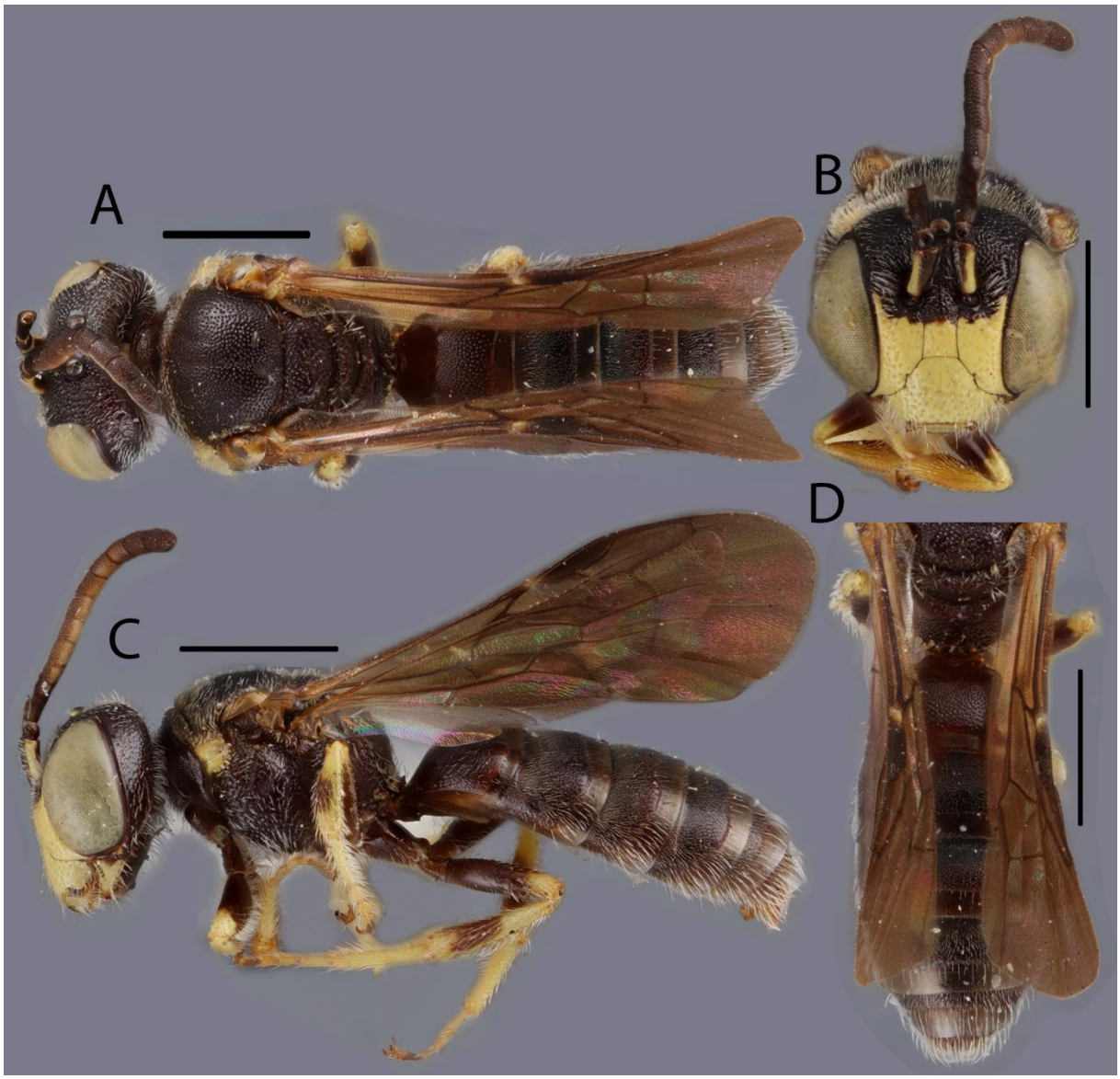


Figure 19. *Protandrena* (*Pterosarus*) *alveus*, ♂. TAMU-ENTO X1340046. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

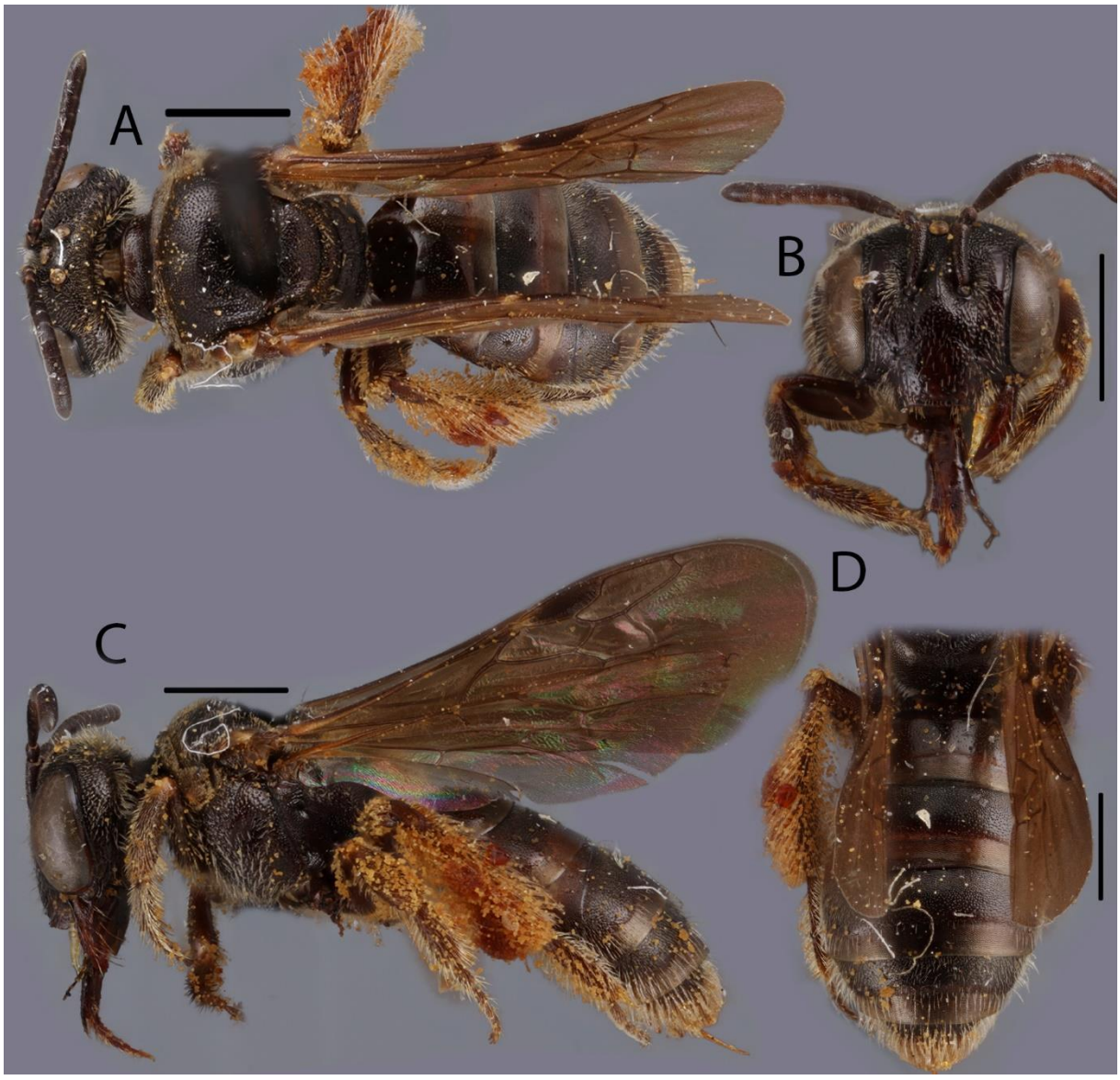


Figure 20. *Protandrena* (*Pterosarus*) *alveus*, ♀. TAMU-ENTO X1329294. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena alveus* is active from mid-September to mid-October. All floral records for the species are from the tribe Astereae.

***Protandrena* (*Pterosarus*) *amor* new species**

(Figure 21, Figure 22)

Diagnosis:

Males of *Pr*. (*Pt*.) *amor* can be recognized by a combination of their long face (HL/HW ratio > 0.9) (contrast all except: *Pr. bidentis*, *Pr. barberi*, *Pr. chepesepe*, *Pr. citrinifrons*, *Pr. illustris*, *Pr. irregularis*, *Pr. labrosa*, *Pr. labrosiformis*, *Pr. leucoptera*, *Pr. nudescens*, *Pr. perlaevis*, *Pr. piercei*, *Pr. renimaculata*, *Pr. solidaginis*) face not entirely yellow below antennae (contrast *Pr. chepesepe*, *Pr. irregularis*, *Pr. leucoptera*, *Pr. nudescens*, *Pr. piercei*, *Pr. renimaculata*), pronotal lobes yellow (contrast *Pr. bidentis*, *Pr. citrinifrons*, *Pr. illustris*, *Pr. solidaginis*) and uniformly sparse scutum punctures (IS = 1 PD) (contrast *Pr. barberi*, *Pr. labrosa*, *Pr. labrosiformis*, *Pr. perlaevis*).

Females of *Pr*. (*Pt*.) *amor* can be recognized by a combination of their yellow pronotal lobes (contrast all except *Pr. albipes*, *Pr. alveus*, *Pr. barberi*, *Pr. labrosa*, *Pr. occidua*, *Pr. ornatipes*, *Pr. quadrapylae*, *Pr. ximenesiae*), impunctate posterior face of propodeum (contrast *Pr. albipes*, *Pr. alveus*, *Pr. occidua*, *Pr. ornatipes*, *Pr. quadrapylae*, *Pr. ximenesiae*), mesopleuron uniformly sparse throughout (IS > 1 PD) (contrast *Pr. labrosa*), and triangular labral process (contrast *Pr. barberi*).

Etymology:

From the Latin amor (‘love’) in honour of my aunt Cheryl Doyle, without whom this research would not have been possible.

Material examined:

USA – **Texas** • 1♂; Travis, Austin, BFL; 30.285° N, 97.731° W; 21 Oct. 2018; Neff J.L. leg.; ex *Verbesina virginica*; CTMI • 1♀; same location as preceding; 21 Oct. 2018; Neff J.L. leg.; ex *Viguiera dentata*; CTMI

Description

Male:

Structure: Body length 7 mm. Head broader than long (HL/HW ratio 0.93). Face below antennae convex. Labral process trapezoidal, broader than long, apex emarginate. Clypeus without median impressed line. Compound eyes convergent below (UOD/LOD ratio 1.2). Posterior ocelli 0.31 mm apart. Flagellomeres longer than broad. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.16 mm. Metapostnotum extended medially 25–50% way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.11 mm. S6 notch deep, extending approximately 1/2 of disk, lateral carina absent.

Sculpture: Clypeus punctation fine and sparse (IS = 1 PD). Paraocular punctation fine and sparse (IS = 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 0.5 MOD from dorsal tangent of antennal socket. Frons punctation fine and dense (IS < 1 PD). Vertex punctation fine and dense (IS < 1 PD). Mesoscutum punctation fine and sparse (IS = 1 PD). Scutellum punctation fine and dense (IS < 1 PD). Mesopleuron punctation fine and sparse (IS > 1 PD). Lateral propodeum punctation fine and dense (IS < 1 PD). Posterior propodeum punctation fine and sparse (IS > 1 PD). Posterior propodeum not microsculptured. Dorsal face of T1 punctation fine and sparse (IS > 1 PD). T2 basal impression deep, approximately 1/2 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus yellow. Supraclypeal area yellow to within 1.5 MOD of antennal socket. Lower paraocular area yellow reaching clypeus medially and extending along margin of compound eyes terminating 1/2 way up antennal socket. Labral process yellow. Mandible yellow. Scape black. Flagellomeres F2-F8 yellow ventrally. Pronotal lobe yellow. Tegula brown. Wing veins and stigma brown, membrane light brown. Fore tibia yellow anteriorly dark posteriorly, mid and hind tibia yellow apically and basally. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, yellow. Scutellum pilosity short, yellow. Mesopleuron pilosity medium-length, white. Sternite pubescence colour yellow. S3 pubescence medium-length, sparse. S4 pubescence medium-length, sparse. S5 pubescence long, medially directed apicolateral fringes.

Female:

Structure: Body length 7.9 mm. Head broader than long (HL/HW ratio 0.9). Face below antennae convex. Labral process triangular, longer than broad, apex rounded. Clypeus without median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.05). Posterior ocelli 0.35 mm apart. Flagellomeres broader than long. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.52 mm. Metapostnotum weakly extended medially <25% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.62 mm.

Sculpture: Clypeus punctation fine and dense (IS < 1 PD). Paraocular punctation fine and dense (IS < 1 PD). Supraclypeal area punctation fine and dense (IS < 1 PD). Fovea clavate. Foveae converging above, narrow end terminating in line with dorsal tangent of antennal socket. Frons finely reticulate. Vertex punctation fine and dense (IS < 1 PD). Mesoscutum punctation fine and sparse (IS = 1 PD) denser along posterior border (IS < 1 PD). Scutellum punctation fine and

dense (IS < 1 PD). Mesopleuron punctation fine and sparse (IS > 1 PD). Lateral propodeum punctation fine and dense (IS < 1 PD). Posterior propodeum punctation absent. Posterior propodeum tessellate. Dorsal face of T1 punctation fine and sparse (IS > 5 PD). T2 basal impression shallow, entire face densely punctate (IS < 1 PD). T3 punctation sparse (IS = 1 PD). T4 punctation sparse (IS = 1 PD).

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F3-F8 yellow ventrally. Pronotal lobe yellow. Tegula brown. Wing veins and stigma brown, membrane hyaline. Fore and mid tibia broadly yellow basally. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, yellow. Scutellum pilosity medium-length, yellow. Mesopleuron pilosity long, yellow. Sternite pubescence colour yellow. S3 pubescence medium-length, sparse. S4 pubescence medium-length, sparse. S5 pubescence medium-length, sparse.

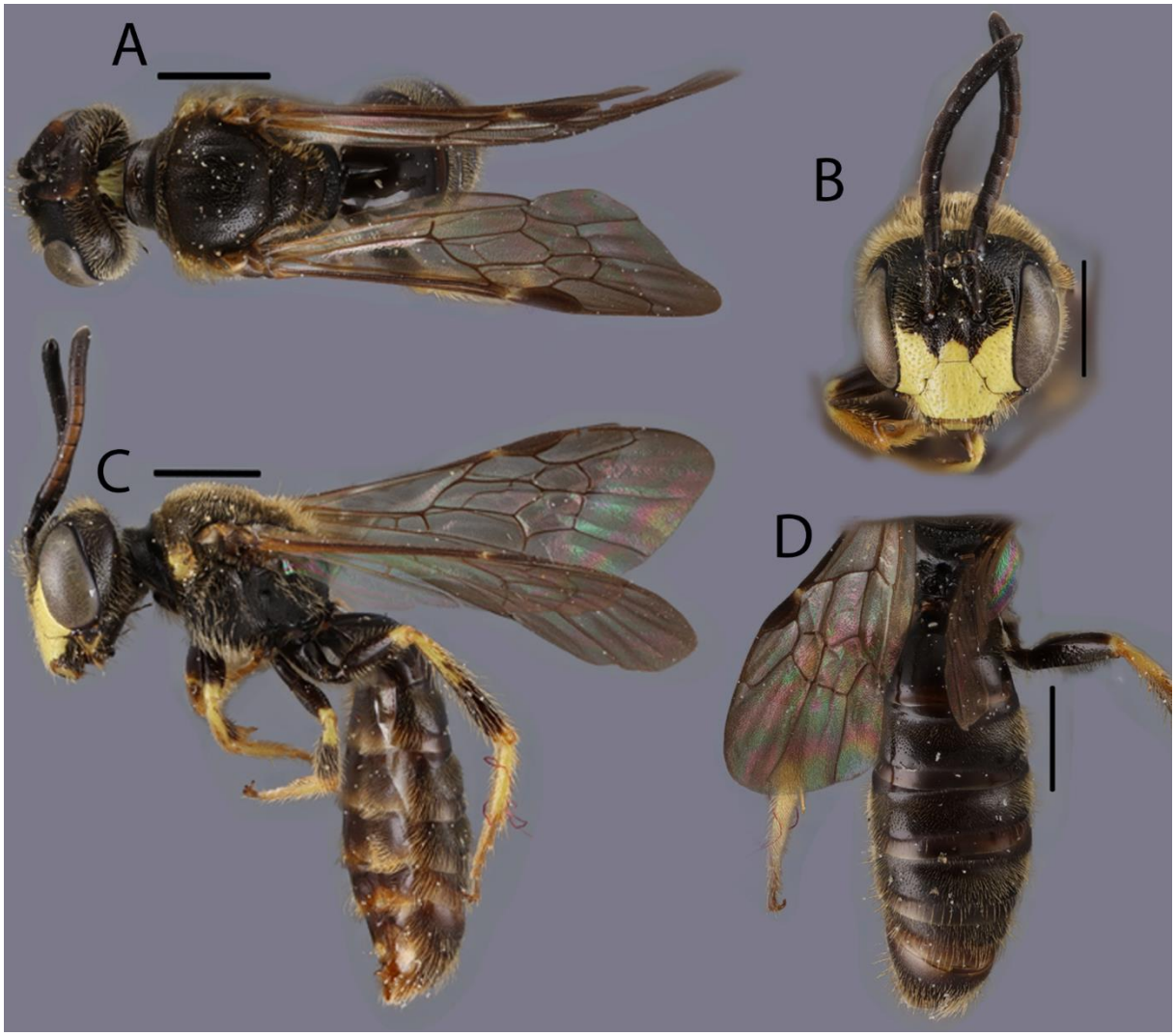


Figure 21. *Protandrena* (*Pterosarus*) *amor*, ♂. CTMI_39113. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

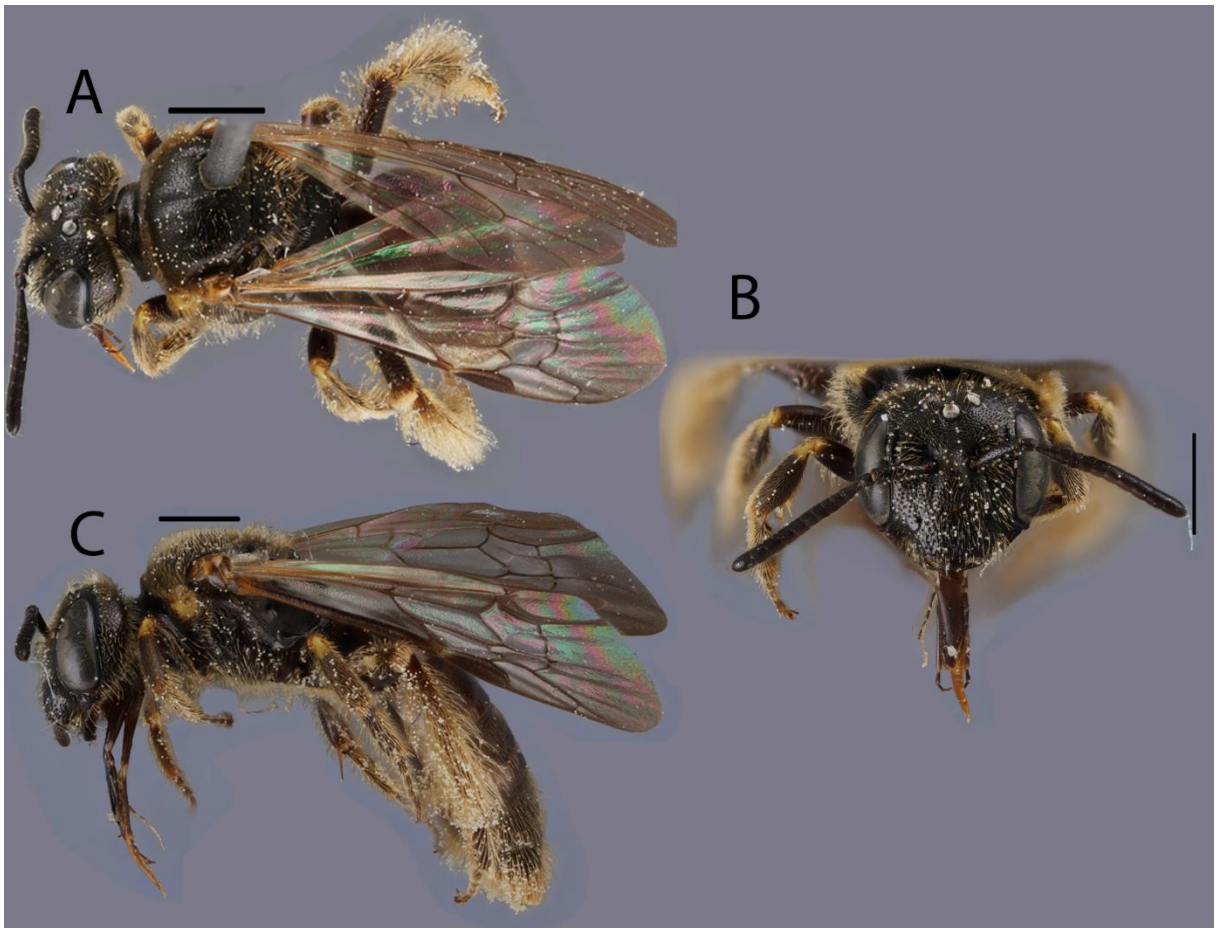


Figure 22. *Protandrena* (*Pterosarus*) *amor*, ♀. CTMI_39123. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

***Protandrena* (*Pterosarus*) *andrenoides* (Smith)**

(Figure 23, Figure 24)

Scrapter andrenoides Smith, 1853: 121. ♀ Syntypes ♀ NHMUK: 14026031. Type locality: USA; Ohio: Mount Pleasant. Examined by photos.

Calliopsis asteris Robertson, 1895: 121. ♀♂. Lectotype ♀ INHS: 15686. Lectotype designation by W. E. LaBerge in Webb (1980). Synonymy by Mitchell 1960. Type locality: USA; Illinois, Macoupin Co., Carlinville (Robertson 1928). Examined specimen.

Taxonomy: Cockerell, 1904: 303. ♀ (redescription). – Stevens, 1950: 92. ♂ Additional Description (as *asteris*)) – Mitchell, 1960: 272–273. ♀♂ (synonymy, redescription).

Type specimens: Smith (1853) described *Scrapter andrenoides* from an unknown number of females. Only one syntype is known to me and is selected as the lectotype. Robertson (1895) described *Calliopsis asteri*s from seven female and 23 male syntypes. W.E. LaBerge in Webb (1980) selected a female in the INHS collection as the lectotype.

Diagnosis:

Males of *Pr*. (*Pt*.) *andrenoides* can be recognized by a combination of their finely reticulate anterior and densely punctate (IS < 1 PD) posterior of scutum (contrast all except: *Pr*. *aestivalis*, *Pr*. *alveus*, *Pr*. *boylei*, *Pr*. *citripes*, *Pr*. *nudescens*, *Pr*. *occidua*), and face not fully yellow below antennae (contrast all remaining).

Females of *Pr*. (*Pt*.) *andrenoides* can be recognized by a combination of their non-macrosculptured posterior face of propodeum (contrast all except: *Pr*. *amor*, *Pr*. *albertensis*, *Pr*. *barberi*, *Pr*. *bidentis*, *Pr*. *dracomons*, *Pr*. *illustris*, *Pr*. *irregularis*, *Pr*. *labrosa*, *Pr*. *perlaevis*, *Pr*. *piercei*), and scutum reticulate anteriorly densely punctate posteriorly (contrast all remaining).

Material examined:

CANADA – **New Brunswick** • 1♀, 1♂♂; Halifax, Birch Cove; [45.0513° N, 66.8373° W]; 16 Aug. 1957; Shewell G.E. leg.; ex *Solidago sempervirens*; CNC • 1♂; same location as preceding; 13 Aug. 1957; Shewell G.E. leg.; ex *Solidago sempervirens*; CNC – **Nova Scotia** • 1♀, 1♂♂; Kings, Greenwich; [45.0838° N, 64.3999° W]; 24 Aug. 2004; Sheffield, Taki, Watsky leg.; RSKM • 1♀; Kings, Somerset; 45.0836° N, 64.7322° W; 05 Sep. 2001; Sheffield C. leg.; RSKM

• 1♀; Kings, West Black Rock; 45.1298° N, 64.7383° W; 16 Aug. 2001; Sheffield C. leg.; ex *Solidago* sp.; RSKM • 1♂; Richmond, Cape Breton, Salem; [45.8122° N, 60.5699° W]; 13 Aug. 1987; Eickwort G.C. leg.; CUIC – **Ontario** • 1♂; Durham, Burketon; [44.0576° N, 78.7944° W]; 30 Aug. 1954; Miller C.D. leg.; CNC • 1♀; Essex, Windsor, Ojibwe Prairie; [42.2574° N, 83.0721° W]; 12 Sep. 2002; Buck M. leg.; PMAE • 1♀, 3♂♂; Haldimand, Dunnville; [42.9035° N, 79.617° W]; 03 Sep. 1954; Lambert R. leg.; CNC • 1♀, 2♂♂; same location as preceding; 03 Aug. 1954; Miller C.D. leg.; CNC • 1♂; Hamilton-Wentworth, Hamilton; [43.2561° N, 79.8575° W]; 18 Aug. 1980; Sanbourne M. leg.; PMAE • 1♀; Hamilton-Wentworth, Hamilton, Flamborough, 5th concession Brock Road (2 km W), Lawson Farm; 43.3161° N, 80.0406° W; 25 Sep. 2002; Buck M. leg.; PMAE • 2♂♂; Hastings, Chatterton; [44.2488° N, 77.4878° W]; 03 Sep. 1949; Martin J.C. leg.; CNC • 1♂; same location as preceding; 09 Sep. 1954; Martin J.C. leg.; CNC • 1♂; Hastings, Eldorado; [44.589° N, 77.52° W]; 01 Sep. 1904; Evans leg.; CNC • 1♂; Hastings, Marmora; [44.4833° N, 77.6833° W]; 10 Sep. 1952; Lambert R. leg.; CNC • 1♀; Kawartha Lakes, Bobcaygeon; [44.5333° N, 78.55° W]; 28 Aug. 1919; Frison T. H. leg.; INHS • 4♂♂; Kawartha Lakes, Lindsay; [44.3566° N, 78.7408° W]; 30 Aug. 1954; Miller C.D. leg.; CNC • 2♀♀; same location as preceding; 30 Aug. 1954; Lambert R. leg.; CNC • 1♀; Leeds and Greenville, Greenbush; [44.6907° N, 75.8454° W]; 19 Aug. 1998; Hainault R. leg.; CNC • 1♀, 2♂♂; Leeds and Grenville, Elizabethtown-Kitley; [44.621° N, 75.773° W]; elev. 112 m.; 14 Aug. 2010; Sones J. leg.; BIO • 1♂; Middlesex, London; [42.9833° N, 81.25° W]; 23 Sep. 1978; Smith D.B. leg.; PMAE • 1♀; same location as preceding; 17 Sep. 1982; Tomlin A. leg.; PMAE • 1♀; Niagara, Jordan; [43.1448° N, 79.3687° W]; 20 Sep. 1916; Ross W.A. leg.; CNC • 1♂; same location as preceding; 12 Sep. 1916; Ross W.A. leg.; CNC • 1♀; same location as preceding; 04 Sep. 1917; Ross W.A. leg.; CNC • 1♀; Niagara, St John's; [43.0755° N, 81.2006°

W]; 01 Sep. 1954; Lambert R. leg.; CNC • 1♂; Norfolk, Dehli Simcoe Railway; [42.8499° N, 80.3907° W]; 21 Sep. 2001; Paiero S. leg.; PMAE • 1♀; Osgoode, Metcalfe; [45.239° N, 75.4708° W]; 08 Aug. 1985; Cooper B.E. leg.; CNC • 1♂; Ottawa-Carleton, Shirleys Bay; [45.3756° N, 75.8946° W]; 05 Aug. 1985; Goulet, Sanborne leg.; PMAE • 1♂; same location as preceding; 29 Jul. 1985; Sanbourne, LeBlanc leg.; PMAE • 1♂; Parry Sound, Rosseau; [45.2599° N, 79.66° W]; 07 Sep. 1963; Bogart J.P. leg.; PMAE • 1♀; Prescott Russell, Gibbs Road; 45.435° N, 74.509° W; 31 Jul. 2016; Gibbs, Nozoe leg.; WRME • 1♀; Thousand Islands, St Lawrence Islands National Park, Grenadier I. Centre; [44.4122° N, 75.8695° W]; 15 Aug. 1975; Sigler E. leg.; CNC • 1♀; same location as preceding; 21 Aug. 1975; Sigler E. leg.; CNC • 1♂; Thousand Islands, St Lawrence Islands National Park, Mallorytown Landing; [44.4549° N, 75.8591° W]; 20 Aug. 1975; Sigler E. leg.; CNC • 1♂; Thousand Islands, St Lawrence Islands National Park, McDonald Island; [44.9193° N, 75.1364° W]; 20 Aug. 1975; Sigler E. leg.; CNC • 1♂; Walpole Island F.N.; [42.5628° N, 82.577° W]; 25 Aug. 1982; Sharkey M. leg.; PMAE • 1♂; Wellington, Elora; [43.6844° N, 80.4301° W]; 16 Aug. 1976; Innes E.A. leg.; PMAE • 1♀; Wellington, Fergus, Backyard on the Grand River; [43.7057° N, 80.3854° W]; 13 Aug. 1993; Marshall S.A. leg.; PMAE • 1♀; Wellington, Guelph; [43.55° N, 80.25° W]; 25 Sep. 1982; Panchinewa W. leg.; PMAE • 1♂; same location as preceding; 10 Sep. 1971; Rollo C.D. leg.; PMAE • 1♂; same location as preceding; 21 Aug. 1978; Farrell M.L.B. leg.; PMAE • 1♂; same location as preceding; 19 Aug. 1978; Menard B. leg.; PMAE • 1♂; same location as preceding; 13 Sep. 1981; Eymann M. leg.; PMAE • 1♂; same location as preceding; 29 Sep. 1981; Eymann M. leg.; PMAE • 1♀; Wellington, Guelph/Eramosa; [43.63° N, 80.22° W]; 05 Sep. 1961; Brumpton G.P. leg.; PMAE • 1♀; Elizabethtown; [44.6213° N, 76.273° W]; elev. 120 m.; 25 Jul. 2010; Sones J. leg.; BIO • 1♀; same location as preceding; 01 Sep. 2010; Sones J. leg.; BIO •

1♀, 1♂; Puslinch; [43.4464° N, 80.2512° W]; elev. 335 m.; 18 Sep. 2008; Terzin T. leg.; BIO – **Prince Edward Island** • 1♀; Queens, Brackley Beach; [46.4055° N, 63.1952° W]; 17 Aug. 1988; Yoshimoto C.M. leg.; CNC – **Quebec** • 1♂; Les Jardins-de-Napierville, Hemmingford; [45.0492° N, 73.5878° W]; 30 Aug. 1916; Beaulne J. I. leg.; CNC • 2♂♂; same location as preceding; 29 Aug. 1916; Beaulne J. I. leg.; CNC • 1♀; Gatineau, Hull; [45.4287° N, 75.7134° W]; 23 Sep. 1965; Mason W.R.M. leg.; CNC

USA – **Alabama** • 1♂; DeKalb, DeSoto State Park; 34.4919° N, 85.6156° W; 24 Sep. 1992; Shiefer T., MacGown J. leg.; MEM • 1♀, 1♂; same location as preceding; 24 Sep. 1992; Brown R., Pollock D. leg.; MEM – **Connecticut** • 2♀♀, 1♂; Fairfield, New Canaan; [41.1468° N, 73.4948° W]; 15 Sep. 1967; Favreau M. leg.; AMNH • 1♂; same location as preceding; 17 Sep. 1967; Favreau M. leg.; AMNH • 1♀, 1♂; Fairfield, Shelton, 120 Beardsley Road; [41.34° N, 73.1649° W]; 01 Sep. 2011; Bulger E Madrid K. leg.; ex *Solidago* sp.; CAES • 1♀; Middlesex, Westbrook, 733 Old Clinton Road; [41.2871° N, 72.4729° W]; 06 Oct. 2020; Vagos K. leg.; CAES • 3♂♂; New London, Bozrah; [41.5113° N, 72.1803° W]; 22 Sep. 2006; Wagner et al. leg.; UCMS • 1♀, 2♂♂; New London, Montville, Powerline ROW 347; [41.4325° N, 72.2333° W]; 03 Sep. 2012; Morrison Gould Sanchez leg.; UCMS • 1♂; New London, Waterford; [41.394° N, 72.156° W]; 22 Sep. 2006; Wagner et al. leg.; UCMS • 1♂; Canaan (3 mi S); [42° N, 73.2° W]; 29 Aug. 1966; Fullerton S.M. leg.; UCMS • 1♀; Soapstone Mountain; [41.96° N, 72.41° W]; 23 Sep. 1972; Campagnano G.J. leg.; UCMS – **Georgia** • 1♀; Lumpkin, Hightower Gap (2 mi E); [34.6635° N, 84.1299° W]; 15 Oct. 1976; Smith C.L., Duffield R.M. leg.; UGCA – **Illinois** • 26♀♀, 27♂♂; Macoupin, Carlinville; [39.2798° N, 89.8818° W]; Robertson C. leg.; AMNH • 3♀♀, 3♂♂; same location as preceding; 09 Sep. 1970; Marlin J. C., LaBerge leg.; INHS • 2♂♂; same location as preceding; 19 Aug. 1970; Marlin J.C. leg.; INHS • 2♂♂; same

location as preceding; 02 Oct. 1971; Marlin J.C. leg.; INHS • 1♀, 3♂♂; same location as preceding; 18 Sep. 1970; Marlin J.C. leg.; INHS • 1♀; same location as preceding; 13 Sep. 1971; Marlin J.C. leg.; INHS • 1♂; same location as preceding; 19 Sep. 1970; Marlin J.C. leg.; INHS • 1♂; same location as preceding; 30 Jun. 1921; Robertson C. leg.; INHS • 1♀; same location as preceding; 1895; Robertson C. leg.; INHS • 1♀; Macoupin, Corbin Hills; 39.246° N, 89.246° W; 23 Sep. 2020; Portman Z. leg.; INHS • 1♀; Macoupin, Moores Cemetary; 39.3056° N, 89.8184° W; 05 Oct. 2020; Portman Z. leg.; INHS – **Indiana** • 1♀, 1♂; Fountain, Portland Arch National Park; [40.2174° N, 87.3365° W]; 24 Sep. 2019; Jean R. leg.; ex *Symphyotrichum* laeve; RJPC • 1♀; Monroe, Morgan-Monroe State Forest; [39.2998° N, 86.3935° W]; 03 Sep. 2018; Jean J. leg.; RJPC • 1♀; Monroe, DePauw University; [39.64° N, 86.86° W]; 05 Sep. 1980; Johnson M.D. leg.; ex *Solidago* sp.; RJPC • 1♂; same location as preceding; 25 Aug. 1977; Johnson M.D. leg.; ex *Rudbeckia* sp.; RJPC • 1♀; Monroe, Kieweg Woods; [39.43° N, 87.5° W]; 01 Sep. 2000; Jean R.P. leg.; ex *Solidago* sp.; RJPC – **Kansas** • 1♀; Monroe, Baldwin (3 mi. SW); [38.775° N, 95.1864° W]; 09 Sep. 1969; Barrows E.M. leg.; ex Cirsium *lanceolatum*; SEMC • 1♀; Monroe, Lawrence; [38.9717° N, 95.2353° W]; 03 Sep. 1984; Michener C.D. Brooks R. leg.; ex *Solidago canadensis*; SEMC – **Maine** • 1♀; Monroe; [43.5719° N, 70.2761° W]; 23 Aug. 2016; Carson R. leg.; BIML • 4♀♀; Monroe, Rangeley; [44.9664° N, 70.6428° W]; 15 Aug. 1925; Schwartz M.F. leg.; AMNH • 1♀; same location as preceding; 09 Aug. 1925; Schwartz M.F. leg.; AMNH • 2♂♂; Monroe; [45.5913° N, 69.9999° W]; 10 Aug. 1966; Nowakowski J., Minacci P. leg.; ex *Solidago* sp.; CUIC • 1♀; Monroe; [45.1151° N, 87.2783° W]; 19 Aug. 2016; Kircus M. leg.; BIML • 1♀; Haynesville (5 mi SW); [45.783° N, 68.076° W]; 09 Sep. 1966; Fullerton S.M. leg.; UCMS – **Massachusetts** • 1♀, 1♂; Berkshire, Great Barrington, old ball field; [42.2371° N, 73.3499° W]; elev. 226 m.; 19 Sep. 2013; Milam J. leg.; ex *Symphyotrichum* sp.; UMNHC –

Michigan • 1♀, 5♂♂; Clinton, Sleepy Hollow State Park; 42.935° N, 84.398° W; 14 Sep. 2013; Gibbs J. leg.; WRME • 2♂♂; Clinton, Sleepy Hollow State Park; 42.932° N, 84.405° W; 07 Sep. 2014; Gibbs J. leg.; WRME • 2♀♀, 8♂♂; Ingham, Lansing, Collins Road ; 42.692° N, 84.496° W; 01 Sep. 2015; Gibbs J. leg.; WRME • 1♀; Ingham, Whitehills Park; 42.753° N, 84.48° W; 04 Sep. 2016; Gibbs J. leg.; WRME • 5♂♂; Kalamazoo, Kalamazoo Nature Center; 42.354° N, 85.591° W; 05 Sep. 2013; Gibbs J. leg.; WRME • 2♀♀; Midland , Averill; 43.6624° N, 84.3505° W; 06 Sep. 2018; ? BH leg.; WRME • 1♀, 1♂; Van Buren, Covert; 42.263° N, 86.229° W; 28 Aug. 2014; Gibbs J. leg.; WRME • 1♀, 1♂; Van Buren, Grand Junction; 42.401° N, 86.126° W; 06 Sep. 2014; Gibbs J. leg.; WRME • 1♀; Van Buren, Skunk Lake; 42.3824° N, 85.9147° W; 14 Sep. 2018; Killewald M. leg.; WRME – **Michigan** • 4♀♀; Barry , Middleville SGA; [42.753° N, 85.368° W]; 10 Sep. 2017; Wood T.J. leg.; WRME • 1♀; Gratiot, Wheeler; [43.418° N, 84.409° W]; 30 Aug. 2018; Wood T.J. leg.; WRME • 1♀; Gratiot, Wheeler; [43.466° N, 84.419° W]; 30 Aug. 2018; Wood T.J. leg.; WRME • 1♀; Isabella, Coleman; [43.763° N, 84.657° W]; 30 Aug. 2018; Wood T.J. leg.; WRME • 2♀♀, 2♂♂; Saginaw, Frankenmuth; [43.351° N, 83.814° W]; 31 Aug. 2018; Wood T.J. leg.; WRME • 1♂; St. Clair, Algonac State Park; [42.65° N, 82.531° W]; 02 Sep. 2017; Wood T.J. leg.; WRME • 1♂; Tuscola, Richville ; [43.382° N, 83.644° W]; 28 Aug. 2018; Wood T.J. leg.; WRME • 1♂; Van Buren, Paw Paw Prairie Fen Nature Preserve ; [42.172° N, 85.768° W]; 27 Aug. 2018; Wood T.J. leg.; WRME – **Minnesota** • 2♀♀; Fillmore, Rushford; 43.8437° N, 91.788° W; 16 Sep. 2014; Leddy S. leg.; WRME • 1♂; Fillmore, Rushford; 43.8401° N, 91.7683° W; 05 Sep. 2014; Leddy S. leg.; WRME • 1♂; Fillmore, Rushford; 43.8437° N, 91.786° W; 01 Sep. 2014; Leddy S. leg.; ex *Symphyotrichum prenanthoides*; WRME • 1♀; Fillmore, Rushford; 43.845° N, 91.7875° W; 24 Aug. 2013; Leddy S. leg.; WRME • 6♂♂; Lyon, Camden State Park; [44.3556° N, 95.9199° W]; 05 Sep. 1974;

UMSP • 1♂; Scott, Raven WMA; 44.5541° N, 93.7428° W; 30 Aug. 2017; Gerjets N. leg.; MNDNR • 1♂; Winona, Wilson; 43.9575° N, 91.6801° W; 07 Aug. 2014; Leddy S. leg.; WRME – **Mississippi** • 4♂♂; Grenada; [33.7826° N, 89.8882° W]; 25 Sep. 1991; Schieffer T.L. leg.; ex *Solidago* sp.; MEM • 1♀, 3♂♂; same location as preceding; 25 Sep. 1991; MacGown J. leg.; ex *Solidago* sp.; MEM • 2♂♂; Oktibbeha, Craig Springs; [33.3153° N, 88.9227° W]; 29 Oct. 1981; Cross W.H. leg.; MEM • 1♂; Oktibbeha, Dorman Lake; [33.338° N, 88.874° W]; 21 Sep. 1981; Brown R.L. leg.; MEM – **Missouri** • 1♀; Wayne, Williamsville; [36.9712° N, 90.5496° W]; 08 Aug. 1988; Becker J.T. leg.; CNC – **New Hampshire** • 2♂♂; Belknap, Meredith; [43.6575° N, 71.5003° W]; 22 Aug. 1960; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 1♂; same location as preceding; 26 Aug. 1960; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 2♂♂; same location as preceding; 27 Aug. 1960; Morse R.A. leg.; ex *Symphyotrichum lateriflorum*; CUIC • 1♂; same location as preceding; 29 Aug. 1960; Morse R.A. leg.; ex *Symphyotrichum lateriflorum*; CUIC • 1♂; same location as preceding; 01 Sep. 1960; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 1♂; same location as preceding; 18 Aug. 1962; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 2♂♂; same location as preceding; 27 Aug. 1962; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 2♂♂; same location as preceding; 31 Aug. 1962; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 3♂♂; same location as preceding; 18 Aug. 1966; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 1♀, 2♂♂; Belknap; [43.5024° N, 71.4074° W]; 23 Aug. 1960; Morse R.A. leg.; ex *Eurybia macrophylla*; CUIC • 1♂; same location as preceding; 24 Aug. 1960; Morse R.A. leg.; ex *Eurybia macrophylla*; CUIC • 1♂; same location as preceding; 30 Aug. 1960; Morse R.A. leg.; ex *Symphyotrichum lateriflorum*; CUIC • ♂; Cheshire, Pitcher Mountain; 43.0939° N, 72.135° W; elev. 656 m.; 10 Aug. 2014; Wyman E.S. leg.; AMNH • 2♀♀; Coos, Mount Washington, Near Pinkam Notch; [44.26° N, 71.25° W]; 28 Aug. 1974; Stage G.I. leg.; UCMS • 2♂♂; Grafton;

[43.9088° N, 71.826° W]; 20 Jul. 1963; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 3♂♂; Sullivan; [43.377° N, 72.2364° W]; 22 Jul. 1963; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 1♀, 1♂; White Mountain National Forest, Passaconaway Campground (1 mi E); [43.996° N, 71.35° W]; 17 Aug. 1968; Fullerton S.M. leg.; UCMS – **New Jersey** • 2♀♀; Princeton; [40.334° N, 74.6708° W]; 16 Sep. 2015; Roswell M. leg.; ex *Symphyotrichum racemosum*; RUIC: RW • 2♀♀; same location as preceding; 20 Sep. 2015; Roswell M. leg.; ex *Solidago* bicolor; RUIC: RW • 1♀; same location as preceding; 07 Oct. 2015; Roswell M. leg.; ex *Symphyotrichum racemosum*; RUIC: RW • 1♀; same location as preceding; 16 Sep. 2015; Roswell M. leg.; ex *Solidago* bicolor; RUIC: RW • 1♀; same location as preceding; 20 Sep. 2015; Roswell M. leg.; ex *Symphyotrichum racemosum*; RUIC: RW • 1♀; same location as preceding; 15 Sep. 2015; Roswell M. leg.; RUIC: RW • 1♀; [40.6676° N, 75.0479° W]; 13 Sep. 2011; DPC leg.; ex *Solidago* gigantea; RUIC: RW – New York • 4♀♀, 3♂♂; Cayuga, Fair Haven Beach State Park; [43.3211° N, 76.6972° W]; 21 Aug. 1998; Danforth B.N. leg.; CUIC • 1♂; Erie, Gowanda; [42.4631° N, 78.9359° W]; 30 Aug. 1908; VanDunzee M.C. leg.; CAS • 1♂; Erie, Lancaster; [42.9006° N, 78.6703° W]; 13 Sep. 1908; VanDunzee M.C. leg.; CAS • 1♀; Essex, Keene Valley; [44.1898° N, 73.786° W]; 16 Aug. 1917; Notman H. leg.; AMNH • 2♂♂; Orange, Cornwall, Black Rock Forest; 41.411° N, 74.007° W; 11 Sep. 2003; Giles V., Rozen J.G. leg.; AMNH • 1♀, 1♂; same location as preceding; 06 Sep. 2003; Giles V., Rozen J.G. leg.; AMNH • 2♂♂; same location as preceding; 21 Sep. 2003; Giles V., Rozen J.G. leg.; AMNH • 2♀♀; Sullivan, Roscoe; [41.9331° N, 74.9135° W]; 18 Sep. 1983; Eickwort G.C. leg.; CUIC • 1♂; Tompkins, Ithaca; [42.444° N, 76.5019° W]; 12 Sep. 1966; CUIC • 1♀; Tompkins, Ithaca; [42.4406° N, 76.4966° W]; 28 Sep. 1986; Deyrup M.A. leg.; AMNH • 1♀; Tompkins, Ithaca, Beebe Lake; [42.451° N, 76.4762° W]; 30 Aug. 1997; Ascher J.S. leg.; AMNH • 2♂♂;

Tompkins, Ithaca, Cornell U. Plantations Botanical Garden; 42.45° N, 76.47° W; 31 Aug. 2012; Hedtke S. leg.; WRME • 1♀, 1♂; Tompkins, Ithaca, Cornell University campus; [42.4534° N, 76.4735° W]; 24 Aug. 1981; Eickwort G.C. leg.; CUIC • 2♀♀; same location as preceding; 26 Aug. 1981; Eickwort G.C. leg.; ex *Solidago* sp.; CUIC • 1♀; Tompkins; [42.4576° N, 76.5488° W]; 16 Aug. 1960; Ramdas J. leg.; ex *Solidago* sp.; CUIC • 9♀♀; same location as preceding; 17 Aug. 1960; Ramdas J. leg.; ex *Solidago* sp.; CUIC • 1♂; same location as preceding; 18 Aug. 1960; Ramdas J. leg.; ex *Solidago* sp.; CUIC • 8♀♀, 18♂♂; same location as preceding; 24 Aug. 1960; Ramdas J. leg.; ex *Solidago* sp.; CUIC • 26♀♀, 15♂♂; same location as preceding; 25 Aug. 1960; Ramdas J. leg.; ex *Solidago* sp.; CUIC • 14♀♀, 13♂♂; same location as preceding; 26 Aug. 1960; Ramdas J. leg.; ex *Solidago* sp.; CUIC • 2♀♀; same location as preceding; 02 Sep. 1960; Ramdas J. leg.; ex *Solidago* sp.; CUIC • 1♀; same location as preceding; 06 Sep. 1960; Ramdas J. leg.; ex *Solidago* sp.; CUIC • 5♂♂; same location as preceding; 08 Sep. 1960; Ramdas J. leg.; ex *Solidago* sp.; CUIC • 2♂♂; same location as preceding; 15 Sep. 1960; Ramdas J. leg.; ex *Solidago* sp.; CUIC • 1♂; same location as preceding; 27 Aug. 1958; Graham J. leg.; ex *Solidago* sp.; CUIC • 1♂; same location as preceding; 08 Sep. 1958; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 5♂♂; same location as preceding; 09 Sep. 1958; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 1♂; same location as preceding; 14 Sep. 1958; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 3♀♀, 2♂♂; same location as preceding; 24 Sep. 1960; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 2♀♀, 4♂♂; same location as preceding; 25 Sep. 1960; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 2♀♀, 11♂♂; same location as preceding; 16 Sep. 1962; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 1♀; same location as preceding; 17 Sep. 1963; McDonald J.L. leg.; ex *Solidago* sp.; CUIC • 1♀; same location as preceding; 23 Sep. 1963; McDonald J.L. leg.; ex *Solidago* sp.; CUIC • 2♀♀; same location as preceding; 27 Sep. 1963; McDonald J.L. leg.; ex

Solidago sp.; CUIC • 1♀; same location as preceding; 24 Aug. 1965; Strang G. leg.; CUIC • 1♂; same location as preceding; 25 Aug. 1960; Ramdas J. leg.; ex *Solidago* sp.; CUIC • 1♂; same location as preceding; 24 Sep. 1960; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 1♂; same location as preceding; 08 Sep. 1960; Ramdas J. leg.; ex *Solidago* sp.; CUIC • 2♂♂; Westchester, Lewisboro; [41.2382° N, 73.5226° W]; 16 Sep. 1972; Favreau M. leg.; AMNH • 2♂♂; same location as preceding; 10 Sep. 1972; Favreau M. leg.; AMNH • 1♀; same location as preceding; 26 Sep. 1965; Favreau M., Favreau T.M. leg.; AMNH • 2♀♀; Tuller Hill State Forest; [42.528° N, 76.1263° W]; 15 Sep. 2014; Harrison T. leg.; RUIC: RW • 1♂; [40.7128° N, 74.006° W]; Jul. 1989; Anagnostopoulos I.T. leg.; PMAE – **North Carolina** • 1♀; Macon, Horse Cove; [35.3644° N, 83.9218° W]; 26 Sep. 1980; Masner L., Bowen C. leg.; CNC • 11♀♀, 16♂♂; McDowell; 37° N, 81.3° W; 09 Sep. 1987; BRC HYM TEAM MT leg.; CNC • 3♀♀, 8♂♂; same location as preceding; Jul. 1987; BRC HYM TEAM MT leg.; CNC • 1♀; same location as preceding; 09 Jul. 1987; BRC Hym Team leg.; RSKM • 3♂♂; McDowell; 37° N, 81.5° W; 09 Jul. 1987; PMAE – **North Dakota** • 1♀, 2♂♂; Cass, Fargo; [46.8772° N, 96.7898° W]; 19 Aug. 1917; Stevens O.A. leg.; ex *Solidago canadensis*; AMNH • 1♀, 1♂; same location as preceding; 26 Aug. 1917; Stevens O.A. leg.; ex *Solidago canadensis*; AMNH • 2♂♂; same location as preceding; 08 Sep. 1913; Stevens O.A. leg.; ex *Symphyotrichum lanceolatum* var. *lanceolatum*; AMNH – **Ohio** • 1♂; Columbiana, Homeworth; [40.8257° N, 81.081° W]; 02 Oct. 2020; Carson Ciesinski leg.; OSUC: KG • 1♀; Geauga, Burton; [41.442° N, 81.1849° W]; 14 Sep. 2020; Linda Gilbert leg.; OSUC: KG • 1♀; Jefferson, Mount Pleasant; [40.0945° N, 84.7072° W]; Smith leg.; NHMUK • 2♀♀, 1♂; Mahoning; [40.9872° N, 80.7214° W]; 31 Aug. 1926; Kennedy C.H. leg.; OSUC • 1♂; Medina, Seville; [41.0162° N, 81.9401° W]; 12 Sep. 2020; Stitt B. leg.; OSUC: KG • 1♂; Portage, Mantua; [41.2737° N, 81.1598° W]; 27 Sep. 2021; Heath B. leg.; ex

Symphyotrichum lateriflorum; OSUC: KG • 1♂; Portage, Morgan Park; [41.23° N, 81.2274° W]; 17 Sep. 2021; Heath B. leg.; ex *Symphyotrichum* sp; OSUC: KG • 1♂; Sandusky, Lindsey; [41.4194° N, 83.2194° W]; 24 Sep. 2020; Helen Hollis leg.; OSUC: KG • 1♂; Stark, Uniontown; [40.9464° N, 81.3541° W]; 05 Oct. 2020; Poremski J. leg.; OSUC: KG • 1♂; Washington, Elk Run; [39.5001° N, 81.2486° W]; 13 Sep. 2021; Laura Hughes leg.; ex *Solidago* sp; OSUC: KG • 1♂; Wayne, Wooster; [40.7649° N, 81.9221° W]; 18 Sep. 2020; Chris Frontz leg.; OSUC: KG • 1♀; Williams, Mud Lake; [41.646° N, 84.767° W]; 02 Sep. 2021; Spring M. leg.; OSUC: KG – **Pennsylvania** • 1♀; Butler, Butler (5 km S); [40.8082° N, 79.8341° W]; 21 Aug. 1993; Walters R. leg.; UCMC • 5♂♂; Centre, State College Scotia Barrens, St. Game lands no. 176; [40.7852° N, 77.95° W]; 20 Sep. 2020; Selking R. leg.; ex *Solidago* sp.; PSUC • 2♀♀, 1♂; Centre, State College Scotia Barrens, St. Game lands no. 176 Scotia Pond Trail; [40.8016° N, 77.9441° W]; 07 Sep. 2020; Selking R. leg.; ex *Solidago* sp.; PSUC • 1♀; same location as preceding; 14 Sep. 2020; Selking R. leg.; ex *Solidago* sp.; PSUC • 1♀; same location as preceding; 22 Sep. 2020; Selking R. leg.; ex *Symphyotrichum* sp.; PSUC • 3♀♀; same location as preceding; 08 Sep. 2020; Selking R. Kilpatrick S. leg.; ex *Solidago* sp.; PSUC • 1♀; same location as preceding; 05 Sep. 2020; Selking R. Kilpatrick S. leg.; ex *Solidago* sp.; PSUC • 1♂; same location as preceding; 23 Sep. 2020; Selking R. leg.; ex *Solidago* sp.; PSUC • 1♂; Centre, State College Scotia Barrens, St. Game lands no. 176 Scotia Pond Trail; [40.8076° N, 77.873° W]; 17 Sep. 2020; Selking R. leg.; ex *Solidago* sp.; PSUC • 1♂; Centre, State College Scotia Barrens, St. Game lands no. 176 Scotia Pond Trail; [40.7852° N, 77.95° W]; 15 Sep. 2020; Selking R. leg.; ex *Symphyotrichum* sp.; PSUC • 1♂; Centre, State College Scotia Barrens, St. Game lands no. 176 Scotia Pond Trail; [40.8016° N, 77.9441° W]; 15 Sep. 2020; Selking R. leg.; ex *Solidago* sp.; PSUC • 2♂♂; same location as preceding; 14 Sep. 2020; Selking R. leg.; ex *Solidago* sp.;

PSUC • 1♀; Centre, University Park, Penn State Arboretum; [40.8016° N, 77.9441° W]; 07 Sep. 2020; Selking R. leg.; ex *Solidago* sp.; PSUC – **South Carolina** • 1♀; Aiken, Aiken, Savannah River Nuclear Plant; [33.348° N, 81.7389° W]; 23 Oct. 1954; Cross W.H. leg.; UGCA • 1♂; C. Sandhills NWR; [34.5597° N, 80.2561° W]; 06 Sep. 2006; Droege S.W. leg.; BIML – **Vermont** • 1♂; Addison, McCuen Slang Waterfowl Area; 44.0244° N, 73.3981° W; 30 Aug. 2020; Hardy S. leg.; UVM • 1♂; Addison; 44.0684° N, 73.3557° W; 19 Aug. 2020; Hardy S. leg.; UVM • 1♂; Chittenden, Birds of Vermont Museum; 44.3513° N, 73.0068° W; 31 Aug. 2020; Hardy S. leg.; UVM • 1♂; Franklin, Missisquoi National Wildlife Refuge; 44.9694° N, 73.1535° W; 19 Aug. 2020; Hardy S. leg.; UVM • 2♀♀; Washington, North Branch Nature Center; 44.2868° N, 72.5739° W; 23 Aug. 2020; Hardy S. leg.; UVM • 2♂♂; Washington, North Branch Nature Center; 44.294° N, 72.5788° W; 28 Aug. 2020; Hardy S. leg.; UVM • 2♀♀, 2♂♂; Windsor; [43.4369° N, 72.6151° W]; 19 Aug. 1962; Morse R.A. leg.; ex *Solidago* sp.; CUIC – **West Virginia** • 1♂; Marion; [39.4999° N, 80.1865° W]; 11 Sep. 2018; Hepner M.J. leg.; BIML • 1♀, 1♂; Ritchie; [39.2301° N, 81.0068° W]; 15 Sep. 2018; Hepner M.J. leg.; BIML – **Wisconsin** • 1♀; Grant, Thomas Wet Prairie, T7N R1W Sec 7; [43.101° N, 90.531° W]; 06 Sep. 1997; Williams A.H. leg.; ex *Doellingeria umbellata*; WIRC – • 1♀; 30 Jul. 2012; RSKM • 1♂; same location as preceding; 01 Aug. 1923; Robertson C. leg.; INHS

Description

Male:

Structure: Body length range 4.93–5.85 mm. Head broader than long (HL/HW ratio 0.82). Face below antennae convex. Labral process trapezoidal, broader than long, apex truncate. Clypeus with median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.31).

Posterior ocelli 0.26 mm apart. Flagellomeres longer than broad. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.1 mm. Metapostnotum weakly extended medially <25% way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.13 mm. S6 notch deep, extending approximately 1/2 of disk, lateral carina absent.

Sculpture: Clypeus punctation coarse and dense (IS < 1 PD). Paraocular punctation coarse and dense (IS = 0.5 PD). Supraclypeal area punctation fine and sparse (IS > 2 PD). Fovea clavate. Foveae converging above, narrow end terminating in line with dorsal tangent of antennal socket. Frons punctation reticulate. Vertex punctation reticulate. Mesoscutum punctation reticulate anteriorly sparser posteriorly (IS < 1 PD). Scutellum punctation coarse and dense (IS < 1 PD) reticulate medially. Mesopleuron punctation coarse and dense (IS < 1 PD) reticulate dorsally. Lateral propodeum punctation reticulate. Posterior propodeum rugose. Posterior propodeum tessellate. Dorsal face of T1 punctation fine and sparse medially (IS = 1 PD) denser laterally (IS < 1 PD). T2 basal impression deep, approximately 1/2 of T2 lineolate basally. T3 punctation sparse (IS = 1 PD). T4 punctation absent.

Colour: Clypeus yellow. Supraclypeal area with small yellow mark terminating before dorsal margin of paraocular mark. Lower paraocular area yellow narrowly extending along margin of compound eye and terminate 1 MOD from antennal socket. Labral process yellow. Mandible yellow. Scape black. Flagellomeres F3-F9 orange ventrally. Pronotal lobe yellow. Tegula light brown. Wing veins and stigma brown, membrane light brown. Fore tibia yellow anteriorly dark posteriorly, mid and hind tibia yellow at knee, extending 1/4 down tibia before becoming entirely dark. Tarsi yellow.

Pubescence: Mesoscutum pilosity very short, yellow. Scutellum pilosity short, yellow. Mesopleuron pilosity short, white. Sternite pubescence colour white. S3 pubescence medium length, only present apically. S4 pubescence medium length, only present apically. S5 pubescence long, medially directed apicolateral fringes.

Female:

Structure: Body length range 5.67–6.48 mm. Head broader than long (HL/HW ratio 0.81). Face below antennae convex. Labral process trapezoidal, broader than long, apex rounded. Clypeus without median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.09). Posterior ocelli 0.29 mm apart. Flagellomeres broader than long. Dorsal pronotal carina present. Prosternum not produced. ITD 1.32 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.06 mm.

Sculpture: Clypeus punctation coarse and sparse anteriorly (IS > 1 PD), fine and dense posteriorly (IS < 1 PD). Paraocular punctation rugulose medially, dense laterally (IS < 1 PD). Supraclypeal area punctation fine and dense (IS < 1 PD). Fovea clavate. Foveae converging above, narrow end terminating along midline of antennal socket. Frons punctation coarse and dense (IS < 1 PD) reticulate under median ocellus. Vertex punctation fine and dense (IS < 1 PD). Mesoscutum punctation finely reticulate anteriorly (IS < 0.5 PD) sparser posteriorly (IS < 1 PD). Scutellum punctation fine and sparse (IS > 2 PD) denser medially (IS < 0.5 PD). Mesopleuron punctation coarse and sparse medially (IS = 1 PD) rugose dorsally. Lateral propodeum punctation reticulate. Posterior propodeum punctation absent. Posterior propodeum imbricate. Dorsal face of T1 punctation fine and dense medially (IS < 1 PD) sparser laterally (IS > 1 PD).

T2 basal impression shallow, basal 1/2 of T2 lineolate. T3 punctation dense (IS < 1 PD). T4 punctation absent.

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F5-F9 orange ventrally. Pronotal lobe black. Tegula pale yellow. Wing veins and stigma brown, membrane light brown. Fore and mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity very short, white. Scutellum pilosity of two forms long and short, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium length, sparse. S4 pubescence medium length, sparse. S5 pubescence medium length,

sparse.

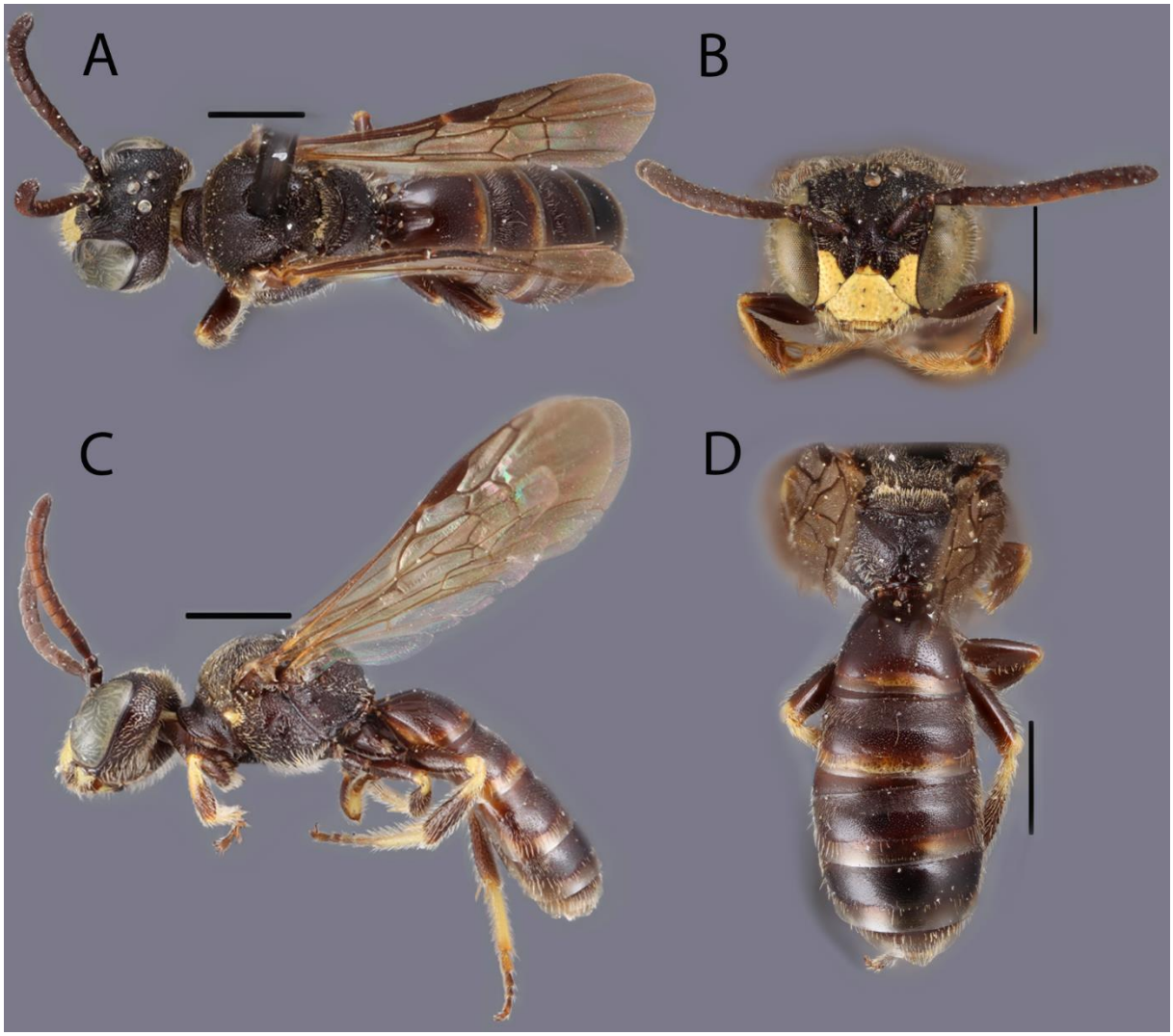


Figure 23. *Protandrena* (*Pterosarus*) *andrenoides*, ♂. CNC. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

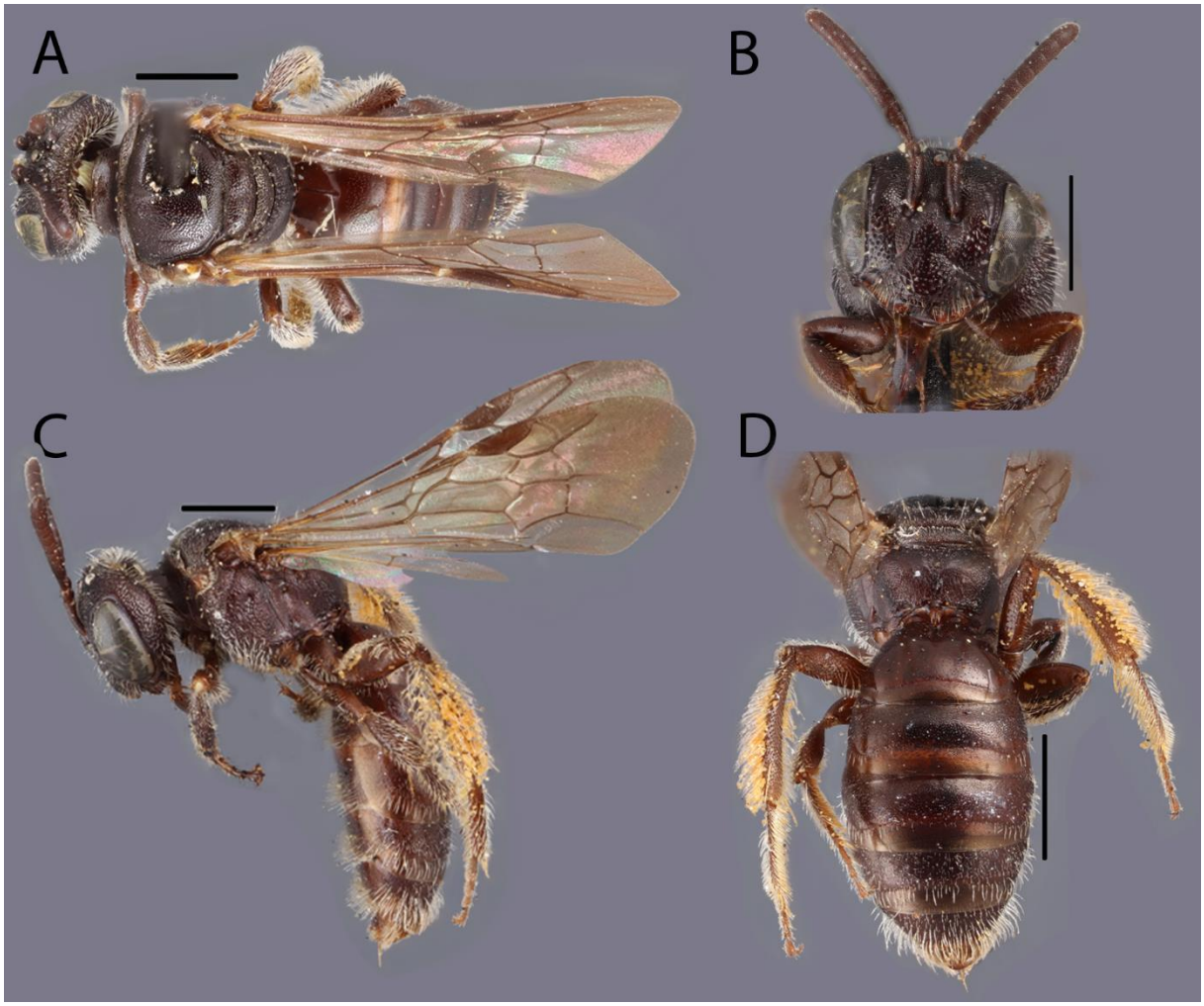


Figure 24. *Protandrena* (*Pterosarus*) *andrenoides*, ♀. CNC. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena andrenoides* is active from early July to early October. Images of *Pr*. (*Pt.*) *andrenoides* in copula show the males to have an interesting mating posture, the male has his legs tucked closely against his body not holding on to the female at all, and his abdomen meets the female's at almost a right angle. Most floral records come from the tribe Astereae with a preference for the genus *Solidago*.

Range: Canada (New Brunswick, Nova Scotia, Ontario, Prince Edward Island, Quebec), USA (Alabama, Connecticut, Georgia, Illinois, Indiana, Kansas, Maine, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Pennsylvania, South Carolina, Vermont, West Virginia, Wisconsin).

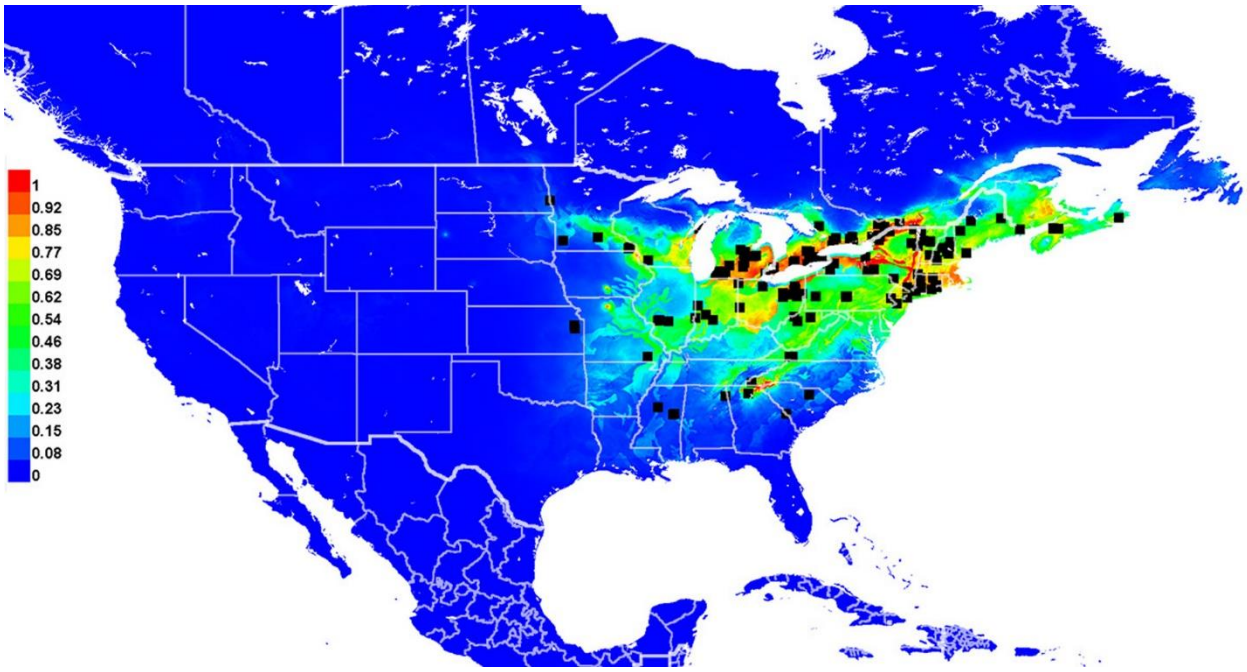


Figure 25. Georeferenced collection records of Protandrena (Pterosarus) andrenoides (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *atricornis* (Cresson)**

(Figure 26, Figure 27)

Calliopsis atricornis Cresson, 1878: 67. ♂. Lectotype ♂ ANSP: 2185. Lectotype designation by Cresson 1916. Type locality: USA; Colorado: Morrison. Examined specimen.

Panurginus altissimus Cockerell, 1922: 3. ♂ Holotype ♂ AMNH: 323868. Type locality: USA; Colorado: Ouray, 11 Jul 1919, about 8000 ft. alt. **New synonymy**. Examined by photos.

Taxonomy: Timberlake, 1967: 21–22 (Tax status …)

Type specimens: Cresson (1878) described *Calliopsis atricornis* from two male syntypes. Cresson (1916) designated a lectotype at ANSP. Cockerell (1922) described *Panurginus altissimus* based on the holotype male and two female paratypes. *Protandrena atricornis* is a distinctive species, which the *Pa. altissimus* type series clearly match. The type localities are separated by approximately 300 km, and that of *Pa. altissimus* is well within the expected range of *Pr. atricornis*.

Diagnosis:

Males of *Pr*. (*Pt*.) *atricornis* are recognized by their broad head (HL/HW ratio 0.82) (contrast all except: *Pr*. *andrenoides*, *Pr*. *luxsolaris*, *Pr*. *skeggox*), and yellow labral process but dark mandibles (contrast all remaining).

Females of *Pr*. (*Pt*.) *atricornis* can be recognized by their very fine sparse scutum punctures posteriorly (IS > 10 PD) that are crowded along anterior border and between parapsidal lines. (contrast all other species).

Material examined

MEXICO – **Michoacán** • 1♂; Cherán (6 mi. N); [19.72° N, 102.02° W]; 28 Jul. 1988; Ferreira Schaffner leg.; TAMUIC • 3♂♂; same location as preceding; 23 Jul. 1983; Kovarik Harrison Schaffner leg.; TAMUIC

USA – **Arizona** • 1♂; Apache, Alpine; [33.8481° N, 109.1431° W]; 01 Aug. 1973; Eickwort G.C. leg.; CUIC • 1♀♀; Cochise, Barefoot Lookout; 31.9165° N, 109.2737° W; 06 Sep. 2003; Ascher J.S. leg.; AMNH • 2♀♀; Cochise, Barefoot Lookout, Barefoot-Rustler Junction; 31.9165° N, 109.2737° W; 26 Aug. 2007; Ascher J.S., Dong C. leg.; AMNH • 5♂♂; Cochise, Chiricahua Mountains, Above Rustler Park; 31.8814° N, 109.2853° W; elev. 2600 m - 2800 m.; 26 Aug. 2000; Brooks R. leg.; ex *Erigeron neomexicanus*; SEMC • 1♀♀; Cochise, Chiricahua Mountains, Barfoot Park; [31.917° N, 109.279° W]; 18 Aug. 2017; OSAC: LP • 7♀♀, 1♂; Cochise, Chiricahua Mountains, near Rustler Park; [31.9034° N, 109.2756° W]; 20 Aug. 2000; Danforth B.N. leg.; ex *Erigeron* sp.; CUIC • 1♀♀; Cochise, Chiricahua Mountains, Onion Saddle; [31.9334° N, 109.2634° W]; 21 Aug. 1964; Rozen J.G., Rozen B.L. leg.; AMNH • 1♀♀; same location as preceding; 06 Sep. 2003; Ascher J.S. leg.; AMNH • 1♀♀; same location as preceding; 17 Aug. 1969; Rozen J.G., Rozen B.L. leg.; AMNH • 1♀♀; same location as preceding; 06 Sep. 2003; Ascher J.S. leg.; AMNH • 1♂; Cochise, Chiricahua Mountains, Pinery Canyon; [31.9331° N, 109.274° W]; 08 Sep. 1950; Boone P., Casier M., Cohn T. leg.; AMNH • 2♀♀; Cochise, Chiricahua Mountains, Rustler Park; [31.9034° N, 109.2756° W]; 20 Aug. 2000; Danforth B.N. leg.; ex Asteraceae sp.; CUIC • 4♀♀, 4♂♂; same location as preceding; 20 Aug. 2000; Danforth B.N. leg.; ex *Erigeron* sp.; CUIC • 3♂♂; same location as preceding; 20 Aug. 2000; Danforth B.N. leg.; ex *Salvia* sp.; CUIC • 1♀♀, 1♂; Cochise, Huachuca Mountains; [31.4001° N, 110.3° W]; elev. 2286 m.; 10 Aug. 1940; Ross E.S. leg.; CAS • 1♂; Cochise, Huachuca Mountains, Carr Canyon; [31.4568° N, 110.257° W]; 26 Aug. 1994; Rozen J.G., Ascher J.S. leg.; AMNH • 1♂; same location as preceding; 03 Sep. 1993; Rozen J.G. leg.; AMNH • 3♀♀; same location as preceding; 24 Aug. 1995; Rozen J.G., Budlick S.A. leg.; ex *Eryngium heterophyllum*; AMNH • 2♀♀; same location as preceding; 26 Aug. 1994; Rozen J.G.,

Ascher J.S. leg.; AMNH • 2♀♀; same location as preceding; 03 Sep. 1993; Rozen J.G. leg.; AMNH • 1♀♀; same location as preceding; 18 Jul. 1993; Sharkey M. leg.; CNC • 11♀♀, 9♂♂; Cochise, Huachuca Mountains, Miller Canyon; [31.2453° N, 110.1633° W]; elev. 2000-3000 m.; 17 Aug. 2000; Danforth B.N. leg.; ex Asteraceae sp.; CUIC • 2♂♂; same location as preceding; 17 Aug. 2000; Danforth B.N. leg.; ex *Salvia* sp.; CUIC • 1♂; same location as preceding; 17 Aug. 2000; Danforth B.N. leg.; CUIC • 9♀♀; Cochise, Huachuca Mountains, Miller Canyon; 31.4011° N, 110.3102° W; elev. 768 m.; 17 Aug. 2000; Brooks R. leg.; ex *Gutierrezia wrightii*; SEMC • 2♂♂; Cochise, Huachuca Mountains, Miller Canyon; [31.2453° N, 110.1633° W]; elev. 607 m - 914 m.; 17 Aug. 2000; Danforth B.N. leg.; CUIC • 31♂♂; Cochise, Huachuca Mountains, Miller Canyon; 31.4011° N, 110.3103° W; elev. 2520 m.; 17 Aug. 2000; Brooks R. leg.; ex *Erigeron neomexicanus*; SEMC • 4♂♂; same location as preceding; 17 Aug. 2000; Brooks R. leg.; ex *Gutierrezia wrightii*; SEMC • 1♀♀; Cochise, Huachucha Mountains, Carr Peak; [31.4128° N, 110.3066° W]; 18 Jul. 1993; Sharkey M. leg.; CNC • 1♂; Cochise, Onion Saddle; 31.933° N, 109.263° W; 26 Aug. 2019; Gibbs J. leg.; WRME • 1♂; Cochise, Onion Saddle; [31.9333° N, 109.2634° W]; 01 Sep. 2014; Spring M. leg.; OSUC: KG • 1♀♀; Cochise, Onion Saddle (1.7 mi. W); 31.931° N, 109.27° W; elev. 2308 m.; 01 Sep. 2015; Neff J.L. leg.; ex *Erigeron* divergens; CTMI • 1♂; Cochise, Onion Saddle (3 mi. W); 31.9333° N, 109.264° W; elev. 2230 m.; 01 Sep. 2015; Neff J.L. leg.; ex *Erigeron* divergens; CTMI • 1♂; Cochise, Portal (22.8 km NW), Rustler Park; 31.9136° N, 109.2672° W; elev. 2420 m.; 20 Aug. 2000; Brooks R. leg.; ex Stevia serrata; SEMC • 1♀♀; Cochise, Portal, Rustler State Park; 31.9136° N, 109.2672° W; elev. 2420 m.; 26 Aug. 2000; Brooks R. leg.; SEMC • 1♀♀; Cochise, Portal, Rustler State Park; [31.372° N, 109.5788° W]; 05 Sep. 1962; Rozen J.G., Statham M., Hessel S.J. leg.; AMNH • 5♀♀, 15♂♂; Cochise, Rustler Park (1 mi. NE); 31.9133° N, 109.2792° W; 20 Aug.

2000; Griswold T.L. leg.; BBSL • 1♀♀; Cochise, Rustler State Park; 31.9967° N, 109.155° W; elev. 2410 m.; 20 Sep. 1999; Brooks R. leg.; ex *Erigeron neomexicanus*; SEMC • 1♀♀; Coconino, Flagstaff (40 mi NW); [35.613° N, 112.1608° W]; elev. 1981 m.; 21 Aug. 1973; Eickwort G.C. leg.; CUIC • 1♀♀; Coconino, Flagstaff (5 mi N); [35.2902° N, 111.5449° W]; elev. 2316 m.; 21 Aug. 1973; Eickwort G.C. leg.; CUIC • 2♂♂; Coconino, Flagstaff, San Francisco Mountains; [35.3408° N, 111.6832° W]; elev. 2438 m.; 13 Aug. 1934; Lutz F.E. leg.; AMNH • 1♀♀; same location as preceding; 10 Aug. 1934; Bell E.L. leg.; AMNH • 2♀♀; Coconino, Heber, Rim rd. (7 mi. N); [34.4314° N, 110.594° W]; 01 Sep. 1951; Bradt G.M. leg.; AMNH • 1♀♀, 2♂♂; Graham, Coronado National Forest; 32.6564° N, 109.8611° W; elev. 2787 m.; 17 Aug. 2001; Brooks R. leg.; ex *Erigeron oreophilus*; SEMC • 1♂; Graham, Mount Graham; [32.7017° N, 109.8715° W]; elev. 2621 m.; 21 Aug. 1997; McAdams B., Rozen J.G. leg.; AMNH • 1♀♀; same location as preceding; 12 Aug. 1933; Bryant O. leg.; CAS • 7♀♀, 11♂♂; Graham, Mount Graham, Above Treasure Flat; 32.6609° N, 109.8675° W; 29 Aug. 2005; Griswold T.L. leg.; BBSL • 1♀♀; Graham, Mount Graham, Safford (20 mi. SW); [32.7017° N, 109.8715° W]; elev. 2438 - 3048 m.; 17 Aug. 2001; ex Asteraceae sp.; CUIC • 4♀♀, 9♂♂; same location as preceding; 17 Aug. 2001; CUIC • 4♀♀, 2♂♂; Graham, Mount Graham, Safford (20 mi. SW); [32.4432° N, 110.7577° W]; elev. 2438 m - 3048 m.; 17 Aug. 2001; CUIC • 1♂; Graham, Pinaleno Mountains; [32.7014° N, 109.8717° W]; elev. 2134 m.; 23 Aug. 1998; Franklin K., Rozen leg.; AMNH • 1♀♀; same location as preceding; 28 Aug. 1996; Rozen J.G, Rozen. B.L., Pence A. leg.; AMNH • 1♀♀; Graham, Pinaleno Mountains, Hospital Flat; [32.665° N, 109.875° W]; 13 Jun. 2017; OSAC: LP • 3♀♀, 4♂♂; Greenlee, Apache-Sitgreaves National Forest, Hannagan Meadow; 33.632° N, 109.3253° W; elev. 2771 m.; 06 Aug. 2017; Tom K.C. leg.; ex *Erigeron subtrinervis*; OSAC: LP • 1♀♀, 1♂; same location as preceding; 06

Aug. 2017; Argueta M.P. leg.; ex *Erigeron subtrinervis*; OSAC: LP • 3♂♂; Greenlee, Apache-Sitgreaves National Forest, Hannagan Meadow; 33.6323° N, 109.3264° W; elev. 2771 m.; 06 Aug. 2017; Fowler J.A. leg.; ex *Erigeron subtrinervis*; OSAC: LP • 1♂; Greenlee, Apache-Sitgreaves National Forest, Hannagan Meadow; 33.632° N, 109.3253° W; elev. 2793 m.; 20 Jul. 2017; Argueta M.P. leg.; ex *Erigeron arizonicus*; OSAC: LP • 1♂; same location as preceding; 06 Aug. 2017; Fowler J.A. leg.; ex *Erigeron flagellaris*; OSAC: LP • 1♂; Greenlee, Apache-Sitgreaves National Forest, Hannagan Meadow; 33.632° N, 109.326° W; elev. 2771 m.; 06 Aug. 2017; Argueta M.P. leg.; ex *Erigeron subtrinervis*; OSAC: LP • 1♂; Greenlee, Apache-Sitgreaves National Forest, Hannagan Meadow; 33.6323° N, 109.3264° W; elev. 2655 m.; 21 Jul. 2017; Fowler J.A. leg.; ex *Erigeron speciosus*; OSAC: LP • 1♂; Greenlee, Apache-Sitgreaves National Forest, Hannagan Meadow; 33.632° N, 109.3253° W; elev. 2655 m.; 20 Jul. 2017; Argueta M.P. leg.; ex *Erigeron arizonicus*; OSAC: LP • 1♂; same location as preceding; 20 Jul. 2017; Argueta M.P. leg.; ex *Erigeron arizonicus*; OSAC: LP • 1♀♀; same location as preceding; 20 Jul. 2017; Argueta M.P. leg.; ex *Achillea millefolium*; OSAC: LP • 2♀♀; same location as preceding; 07 Aug. 2017; Argueta M.P. leg.; ex *Erigeron subtrinervis*; OSAC: LP • 1♀♀; Greenlee, Apache-Sitgreaves National Forest, Hannagan Meadow; [33.632° N, 109.326° W]; 08 Aug. 2018; ex *Erigeron tracyi*; OSAC: LP • 1♀♀; same location as preceding; 20 Jul. 2017; OSAC: LP • 1♀♀; Greenlee, Hannagan Meadow; [33.632° N, 109.326° W]; elev. 2771 m.; 20 Jul. 2017; Argueta M.P. leg.; OSAC: LP • 2♂♂; Navajo, White Mountains; [33.9106° N, 109.5851° W]; Moldenke A.R. leg.; CAS • 1♂; Pima, Catalina Mountains, Junction of Oracle & Catalina Highway; [32.6206° N, 110.801° W]; 28 Aug. 1997; Minckley R.L. leg.; ex *Erigeron* sp.; MCUR • 1♀♀; Pima, Coronado National Forest, Mt. Lemmon; [32.4432° N, 110.7577° W]; elev. 2560 m.; 01 Aug. 1992; Eickwort G.C. leg.; CUIC • 3♀♀, 5♂♂; same location as

preceding; 15 Aug. 2001; CUIC • 1♂; same location as preceding; 01 Aug. 1992; Eickwort G.C. leg.; CUIC • 1♀♀, 2♂♂; Pima, Coronado National Forest, Red Ridge Trail; 32.4533° N, 110.7672° W; elev. 2372 - 2378 m.; 16 Aug. 2001; Brooks R. leg.; ex *Erigeron oreophilus*; SEMC • 1♀♀; Pima, Santa Catalina Mountains; [32.443° N, 110.788° W]; 30 Aug. 1996; Rozen J.G., Rozen B.L. leg.; AMNH • 23♂♂; same location as preceding; Neff J.L. leg.; CAS • 1♀♀, 5♂♂; same location as preceding; Neff J.L. leg.; CUIC • 1♂; Santa Cruz, Santa Rita Mountains, Madera Canyon; [31.7251° N, 110.8801° W]; elev. 2000-2600 m.; 20 Aug. 2000; Danforth B.N. leg.; ex *Salvia* sp.; CUIC • 1♂; Yavapai, Oak Creek; [34.7803° N, 111.7627° W]; 1867; Snow F.H. leg.; SEMC – **Colorado** • 1♂; Bellvue, Pingree Park; 40.561° N, 105.597° W; elev. 2774 m.; 16 Aug. 1933; Rodeck H.G. leg.; UCMC • 2♂♂; Boulder, Jamestown (1 mi. W); 40.125° N, 105.4614° W; elev. 2591 m.; 06 Aug. 1962; Lanham U.N. leg.; UCMC • 1♂; Boulder, Rocky Mountain National Park, Wild Basin; 40.201° N, 105.612° W; elev. 2966 m.; 28 Jul. 1936; Bauer R. leg.; UCMC • 1♀♀; Chaffee, Buena Vista (6 mi. W); [38.8422° N, 106.1311° W]; 02 Sep. 1962; Kerfoot W.B. leg.; SEMC • 1♀♀, 1♂; Clear Creek, Idaho Springs, West Chicago Creek; [39.6791° N, 105.6574° W]; elev. 2987 m.; 11 Aug. 1961; Stainer J.E.R. leg.; CNC • 1♂; Freemont, Coaldale (5 mi. S); [38.3656° N, 105.7578° W]; elev. 2225 m.; 11 Aug. 1968; Michener C.D., McGee E.K. leg.; ex *Symphyotrichum* sp.; SEMC • 1♀♀, 1♂; Gilpin, Gilpin, Lump Gulch near Gilpin; 39.8865° N, 105.5049° W; elev. 2743-3353 m.; 24 Jul. 1934; Rodeck H.G. leg.; UCMC • 1♀♀, 1♂; same location as preceding; 29 Jul. 1934; Dodelinger N. leg.; UCMC • 2♂♂; Larimer, Estes Park; [40.3772° N, 105.5217° W]; 08 Aug. 1974; Favreau M., Favreau T.M. leg.; AMNH • 1♀♀; same location as preceding; 19 Jul. 1916; AMNH • 1♀♀; same location as preceding; 13 Aug. 1914; AMNH • 1♂; Larimer, Glen Haven; [40.4539° N, 105.4491° W]; 24 Sep. 1945; Lawson P.B. leg.; SEMC • 1♀♀; Larimer; 40.5775° N, 105.5132°

W; 10 Aug. 2016; Runyon J.B. leg.; MTEC • 1♂; Morrison; [39.6536° N, 105.1911° W]; 1878; Cresson leg.; ANSP • 1♂; Ouray, Summit Road; [38.0309° N, 107.6908° W]; 11 Jul. 1919; Cockerell T.D.A. leg.; AMNH • 1♀♀; Teller, Florissant, Florissant Fossil Beds; 38.9093° N, 105.2933° W; elev. 2560 m.; 26 Jul. 1984; Brown F.M. leg.; UCMC • 1♂; Teller, Florissant, Florissant Fossil Beds; 38.9063° N, 105.2791° W; elev. 2560 m.; 11 Aug. 1981; Brown F.M. leg.; ex *Achillea millefolium*; UCMC • 1♂; Teller, Sanborn Ranch; 38.906° N, 105.3106° W; elev. 2621 m.; 17 Jul. 1985; Brown F.M. leg.; UCMC • 5♀♀, 1♂; Cascade Lodge, Rocky Mountain National Park; [40.401° N, 105.603° W]; 02 Aug. 1931; Severin H.C. leg.; SMIC • 1♂; Lake City; [38.03° N, 107.32° W]; elev. 9000 ft. m.; 08 Aug. 1938; Fluke C.L. leg.; WIRC • 1♀♀; 12 Aug. 1935; Cockerell T.D.A. leg.; SEMC – **New Mexico** • 6♀♀, 1♂; Bernalillo, Cibola National Forest, Kiwanis Meadow; 35.2052° N, 106.4424° W; elev. 3057 m.; 03 Aug. 2017; Argueta M.P. leg.; ex *Erigeron subtrinervis*; OSAC: LP • 2♀♀; same location as preceding; 04 Aug. 2017; Argueta M.P. leg.; ex *Erigeron subtrinervis*; OSAC: LP • 1♂; same location as preceding; 03 Aug. 2017; Argueta M.P. leg.; ex *Campanula rotundifolia*; OSAC: LP • 2♀♀, 2♂♂; same location as preceding; 04 Aug. 2017; Fowler J.A. leg.; ex *Erigeron subtrinervis*; OSAC: LP • 1♀♀; same location as preceding; 14 Jul. 2017; Fowler J.A. leg.; ex *Erigeron subtrinervis*; OSAC: LP • 5♀♀; same location as preceding; 03 Aug. 2017; Tom K.C. leg.; ex *Erigeron subtrinervis*; OSAC: LP • 1♀♀; Bernalillo, Cibola National Forest, Kiwanis Meadow; 35.2058° N, 106.4423° W; elev. 3057 m.; 03 Aug. 2017; Argueta M.P. leg.; ex *Erigeron subtrinervis*; OSAC: LP • 2♀♀; same location as preceding; 04 Aug. 2017; Argueta M.P. leg.; ex *Erigeron subtrinervis*; OSAC: LP • 2♀♀; same location as preceding; 14 Jul. 2017; Argueta M.P. leg.; ex *Erigeron flagellaris*; OSAC: LP • 3♀♀; same location as preceding; 03 Aug. 2017; Fowler J.A. leg.; ex *Erigeron subtrinervis*; OSAC: LP • 1♀♀; same location as preceding; 13

Jul. 2017; Fowler J.A. leg.; ex *Cymopterus lemmonii*; OSAC: LP • 2♀♀; same location as preceding; 03 Aug. 2017; Tom K.C. leg.; ex *Erigeron subtrinervis*; OSAC: LP • 9♀♀, 2♂♂; same location as preceding; 04 Aug. 2017; Tom K.C. leg.; ex *Erigeron subtrinervis*; OSAC: LP • 6♀♀; Bernalillo, Cibola National Forest, Kiwanis Meadow; 35.2059° N, 106.4431° W; elev. 3057 m.; 03 Aug. 2017; Argueta M.P. leg.; ex *Erigeron subtrinervis*; OSAC: LP • 1♀♀; same location as preceding; 03 Aug. 2017; Tom K.C. leg.; ex *Erigeron subtrinervis*; OSAC: LP • 2♀♀, 2♂♂; same location as preceding; 04 Aug. 2017; Tom K.C. leg.; ex *Erigeron subtrinervis*; OSAC: LP • 9♀♀; Bernalillo, Sandia Mountains, Kiwanis; [35.205° N, 106.442° W]; 26 Jul. 2018; OSAC: LP • 3♀♀; same location as preceding; 24 Aug. 2018; OSAC: LP • 3♀♀; same location as preceding; 03 Aug. 2017; OSAC: LP • 1♀♀; same location as preceding; 14 Jul. 2017; OSAC: LP • 1♀♀; same location as preceding; 25 Jul. 2018; OSAC: LP • 3♀♀; Bernalillo, Sandia Mountains, Kiwanis Meadow; [35.205° N, 106.442° W]; 25 Jul. 2018; OSAC: LP • 1♂; Colfax, Eagle Nest (3 mi. E); [36.5548° N, 105.2636° W]; 14 Aug. 1971; Rozen J.G., Rozen B.L., Rozen K.C. leg.; AMNH • 2♀♀, 8♂♂; Grant, Gila National Forest, McMillan Campground (1.5 km NE) along Cherry Creek; 32.934° N, 108.2032° W; 30 Aug. 2009; Griswold T.L. leg.; BBSL • 2♂♂; Grant, Gila National Forest, McMillan Campground (1.5 km NE) along Cherry Creek; 33.934° N, 108.2032° W; 02 Sep. 2010; Griswold T.L. leg.; ex *Erigeron* sp.; BBSL • 1♂; Grant, Mimbres (19 mi. N); 33.1237° N, 108.0071° W; elev. 2434 m.; 27 Aug. 2000; Hicks A.L., Scott V. leg.; ex *Geranium*; UCMC • 1♀♀; Greenlee, Apache-Sitgreaves National Forest, Hannagan Meadow; 33.632° N, 109.3253° W; elev. 2793 m.; 07 Aug. 2017; Argueta M.P. leg.; ex *Erigeron subtrinervis*; OSAC: LP • 1♂; Lincoln, Kraut Canyon, Near Bonito Lake; 33.4609° N, 105.7356° W; 28 Jul. 2009; Griswold T.L. leg.; BBSL • 1♂; Lincoln, Philadelphia Canyon, Bonito Lake (3.6 km E); 33.4519° N, 105.6942° W; 28 Jul.

2009; Griswold T.L. leg.; BBSL • 1♀♀, 4♂♂; Mora, Holman (6 mi. NW); [36.0384° N, 105.3836° W]; 29 Jul. 1972; Eickwort G.C. leg.; CUIC • 4♀♀; Mora, Pecos, Jacks Creek; [35.842° N, 105.654° W]; 23 Aug. 2018; OSAC: LP • 1♀♀; Otero, Cloudcroft; [32.9573° N, 105.7425° W]; elev. 2591 m.; 31 Jul. 1972; Eickwort G.C. leg.; CUIC • 1♀♀; Sandoval, Jemez, Valles Caldera; [35.873° N, 106.488° W]; 09 Aug. 2017; OSAC: LP • 1♂; Sandoval, La Cueva (15 mi. NW); [35.9883° N, 106.8735° W]; 11 Aug. 1965; Leech H.B. leg.; CAS • 6♀♀, 4♂♂; Sandoval, Valles Caldera, Cerro Del Medio Meadow; 35.9218° N, 106.5177° W; elev. 2793 m.; 09 Aug. 2017; Argueta M.P. leg.; ex *Erigeron formosissimus*; OSAC: LP • 3♀♀, 3♂♂; same location as preceding; 09 Aug. 2017; Fowler J.A. leg.; ex *Erigeron formosissimus*; OSAC: LP • 1♀♀, 1♂; same location as preceding; 09 Aug. 2017; Tom K.C. leg.; ex *Erigeron formosissimus*; OSAC: LP • 1♀♀, 1♂; same location as preceding; 10 Aug. 2017; Fowler J.A. leg.; ex *Erigeron formosissimus*; OSAC: LP • 3♀♀; same location as preceding; 10 Aug. 2017; Tom K.C. leg.; ex *Erigeron formosissimus*; OSAC: LP • 5♀♀, 4♂♂; Sandoval, Valles Caldera, Cerro Del Medio Meadow; 35.9221° N, 106.5173° W; elev. 2793 m.; 09 Aug. 2017; Argueta M.P. leg.; ex *Erigeron formosissimus*; OSAC: LP • 3♀♀; same location as preceding; 09 Aug. 2017; Fowler J.A. leg.; ex *Erigeron formosissimus*; OSAC: LP • 6♀♀, 2♂♂; same location as preceding; 09 Aug. 2017; Tom K.C. leg.; ex *Erigeron formosissimus*; OSAC: LP • 3♀♀, 2♂♂; same location as preceding; 10 Aug. 2017; Argueta M.P. leg.; ex *Erigeron formosissimus*; OSAC: LP • 1♀♀, 2♂♂; Sandoval, Valles Caldera, Cerro Del Medio Meadow; 35.9227° N, 106.517° W; elev. 2793 m.; 09 Aug. 2017; Fowler J.A. leg.; ex *Erigeron formosissimus*; OSAC: LP • 4♀♀, 5♂♂; same location as preceding; 09 Aug. 2017; Tom K.C. leg.; ex *Erigeron formosissimus*; OSAC: LP • 1♀♀; same location as preceding; 10 Aug. 2017; Argueta M.P. leg.; ex *Erigeron formosissimus*; OSAC: LP • 1♀♀; Santa Fe, Sante Fe National Forest, Jacks Creek Campground; 35.8548° N,

105.6393° W; elev. 3024 m.; 24 Jul. 2017; Argueta M.P. leg.; ex *Potentilla hippiana*; OSAC: LP • 1♀♀; same location as preceding; 24 Jul. 2017; Fowler J.A. leg.; ex *Erigeron subtrinervis*; OSAC: LP • 1♀♀; Santa Fe, Sante Fe National Forest, Jacks Creek Campground; 35.8555° N, 105.6398° W; elev. 3024 m.; 24 Jul. 2017; Tom K.C. leg.; ex *Erigeron subtrinervis*; OSAC: LP • 1♀♀; Santa Fe, Sante Fe National Forest, Jacks Creek Campground; [35.8391° N, 105.6554° W]; 28 Jul. 2018; ex *Erigeron subtrinervis*; OSAC: LP • 2♀♀; Sierra, Hillsboro; 32.895° N, 107.555° W; elev. 1650 m.; 20 Sep. 1999; Michener C.D. Brooks R. leg.; ex *Heliomeris multiflora* var. *nevadensis*; SEMC • 1♀♀; Socorro, Cibola National Forest, South Baldy Meadow; 33.9901° N, 107.1841° W; elev. 2909 m.; 16 Jul. 2017; Fowler J.A. leg.; ex *Hymenopappus newberryi*; OSAC: LP • 1♀♀; same location as preceding; 17 Jul. 2017; Fowler J.A. leg.; ex *Erigeron formosissimus*; OSAC: LP • 1♀♀; same location as preceding; 01 Aug. 2017; Tom K.C. leg.; ex *Erigeron formosissimus*; OSAC: LP • 1♂; same location as preceding; 01 Aug. 2017; Argueta M.P. leg.; ex *Erigeron formosissimus*; OSAC: LP • 1♂; same location as preceding; 29 Jul. 2017; Argueta M.P. leg.; ex *Erigeron formosissimus*; OSAC: LP • 1♀♀, 2♂♂; Socorro, Cibola National Forest, South Baldy Meadow; 33.9919° N, 107.1836° W; elev. 3718 m.; 01 Aug. 2017; Argueta M.P. leg.; ex *Erigeron formosissimus*; OSAC: LP • 1♀♀, 1♂; same location as preceding; 01 Aug. 2017; Fowler J.A. leg.; ex *Erigeron formosissimus*; OSAC: LP • 3♀♀, 1♂; same location as preceding; 01 Aug. 2017; Tom K.C. leg.; ex *Erigeron formosissimus*; OSAC: LP • 2♂♂; same location as preceding; 29 Jul. 2017; Argueta M.P. leg.; ex *Erigeron formosissimus*; OSAC: LP • 1♂; same location as preceding; 29 Jul. 2017; Fowler J.A. leg.; ex *Erigeron formosissimus*; OSAC: LP • 4♀♀; same location as preceding; 29 Jul. 2017; Tom K.C. leg.; ex *Erigeron formosissimus*; OSAC: LP • 1♀♀; Socorro, Cibola National Forest, South Baldy Meadow; [33.9911° N, 107.1878° W]; 16 Jul. 2017; OSAC: LP • 1♀♀; same location as

preceding; 15 Jul. 2017; OSAC: LP • 1♀♀; Socorro, Magdalena, South Baldy; [33.99° N, 107.187° W]; 16 Jul. 2017; OSAC: LP • 2♀♀; same location as preceding; 15 Jul. 2017; OSAC: LP • 1♂; Taos, Carson National Forest, Agua Piedra Campground; [36.1318° N, 105.5292° W]; elev. 2530 m.; 29 Jul. 1972; Eickwort G.C. leg.; CUIC – **South Dakota** • 1♂; Custer, Highway 16A; [43.8028° N, 103.3446° W]; 30 Jun. 1960; Knox. M., Knox R. leg.; CAS – **Utah** • 1♀♀; Iron, Panguitch (14 mi NW); [37.952° N, 112.6405° W]; elev. 2411 m.; 30 Jul. 1973; Eickwort G.C. leg.; CUIC

Description

Male:

Structure: Body length range 5.92–7.01 mm. Head distinctly broader than long (HL/HW ratio 0.82). Face below antennae convex. Labral process narrowly trapezoidal, longer than broad, apex truncate. Clypeus without median impressed line. Compound eyes convergent below (UOD/LOD ratio 1.16). Posterior ocelli 0.35 mm apart. Flagellomeres about equal in length and width. Dorsal pronotal carina extends laterally to pronotal lobes. Prosternum not produced. ITD 1.34 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.17 mm. S6 notch shallow, only 1/3, lateral carina absent.

Sculpture: Clypeus punctation coarse and dense (IS = 0.5 PD). Paraocular punctation coarse and dense (IS = 0.5 PD). Supraclypeal area punctation fine and sparse (IS >1 PD). Fovea ovate. Foveae slightly converging above, terminating in line with dorsal tangent of antennal socket. Frons punctation reticulate. Vertex punctation fine and sparse (IS = 1 PD). Mesoscutum punctation coarse and sparse (IS = 1 – 2 PD). Scutellum punctation coarse and dense (IS > 1 PD) reticulate medially. Mesopleuron punctation coarse and dense (IS < 1 PD) rugose dorsally.

Lateral propodeum punctation reticulate. Posterior propodeum punctation reticulate. Posterior propodeum not microsculptured. Dorsal face of T1 punctation fine and dense (IS < 1 PD). T2 basal impression deep, basal 1/2 of T2 lineolate. T3 punctation dense (IS < 1 PD). T4 punctation sparse (IS = 1 PD).

Colour: Clypeus yellow. Supraclypeal area with quadrate yellow mark that terminates in line with paraocular mark. Lower paraocular area yellow broadly extending along margin of compound eye terminating ~1.5 MOD from antennal socket. Labral process yellow. Mandible black. Scape black. Flagellomeres dark. Pronotal lobe black. Tegula light brown. Wing veins and stigma brown, membrane smoky. Fore and mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity short, white. Mesopleuron pilosity long, white. Sternite pubescence colour yellow. S3 pubescence short, sparse. S4 pubescence medium length, dense, with medially directed apicolateral fringes. S5 pubescence long, medially directed apicolateral fringes.

Female:

Structure: Body length range 6.4–7.41 mm. Head distinctly broader than long (HL/HW ratio 0.82). Face below antennae convex. Labral process U shaped, longer than broad, apex rounded. Clypeus without median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.06). Posterior ocelli 0.30 mm apart. Flagellomeres broader than long. Dorsal pronotal carina extends laterally to pronotal lobes. Prosternum not produced. ITD 1.5 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.07 mm.

Sculpture: Clypeus punctation mixed sparse coarse and fine punctures (IS = 1 PD). Paraocular punctation coarse and dense medially (IS < 1 PD) sparser laterally (IS > 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 1/2 way down antennal socket. Frons punctation coarse and dense (IS < 1 PD). Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation fine and sparse (IS > 1 PD) extremely sparse posteriorly (IS > 10 PD). Scutellum punctation fine and sparse (IS = 1 PD) denser medially (IS < 1 PD). Mesopleuron punctation fine and sparse (IS > 1 PD) denser and coarser ventrally (IS < 1 PD). Lateral propodeum punctation fine and dense (IS < 1 PD). Posterior propodeum punctation fine and dense (IS < 1 PD). Posterior propodeum imbricate. Dorsal face of T1 punctation very fine and sparse (IS > 3 PD). T2 basal impression shallow, basal 1/3 of T2 lineolate. T3 punctation sparse (IS > 1 PD). T4 punctation sparse (IS > 1 PD).

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F5-F9 orange ventrally. Pronotal lobe black. Tegula yellow. Wing veins and stigma brown, membrane light brown. All tibia dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity medium-length, white. Scutellum pilosity medium-length, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium length, sparse. S4 pubescence medium length, sparse. S5 pubescence long, medially directed apicolateral fringes.

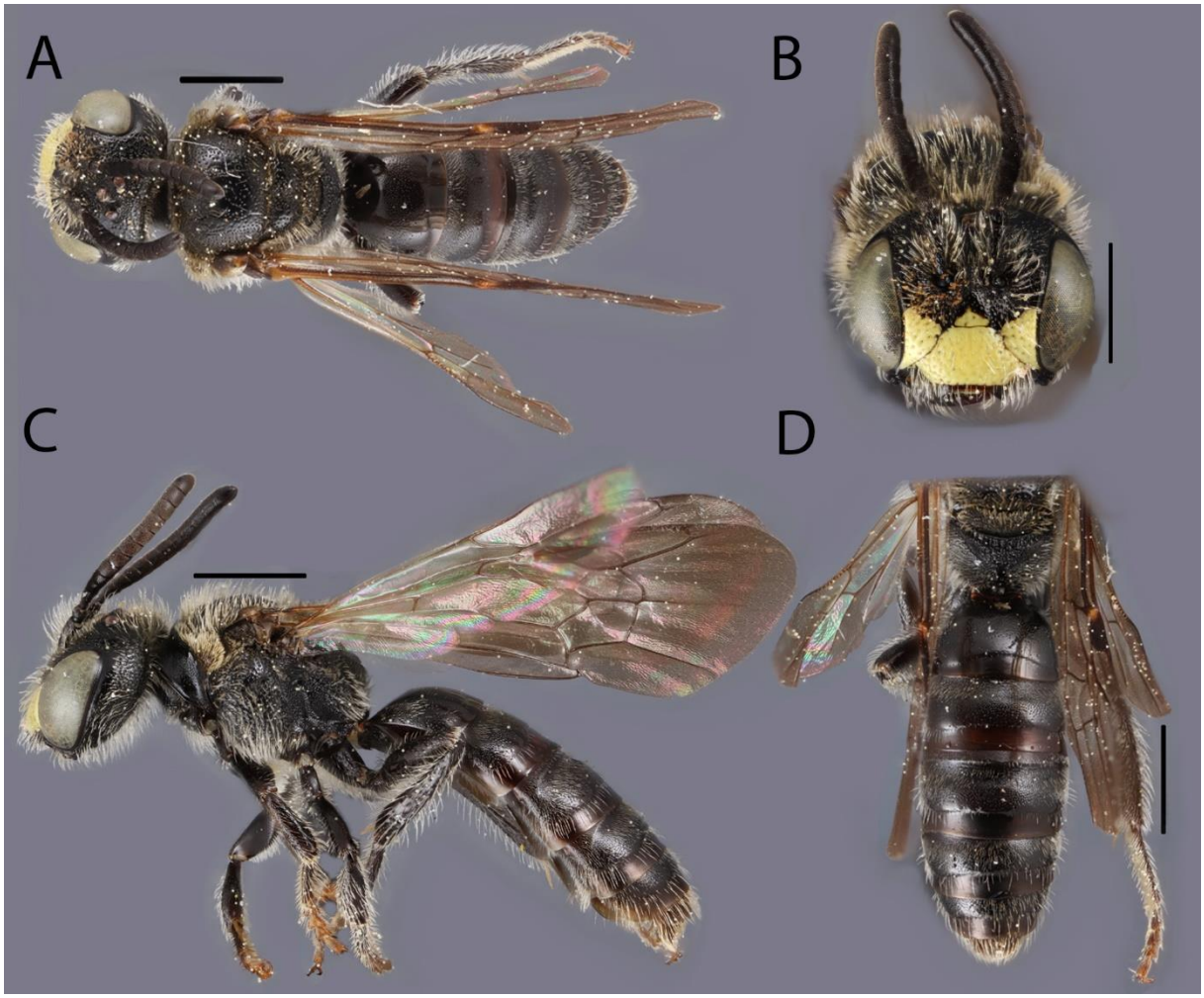


Figure 26. *Protandrena* (*Pterosarus*) *atricornis*, ♂. BBSL_772523. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

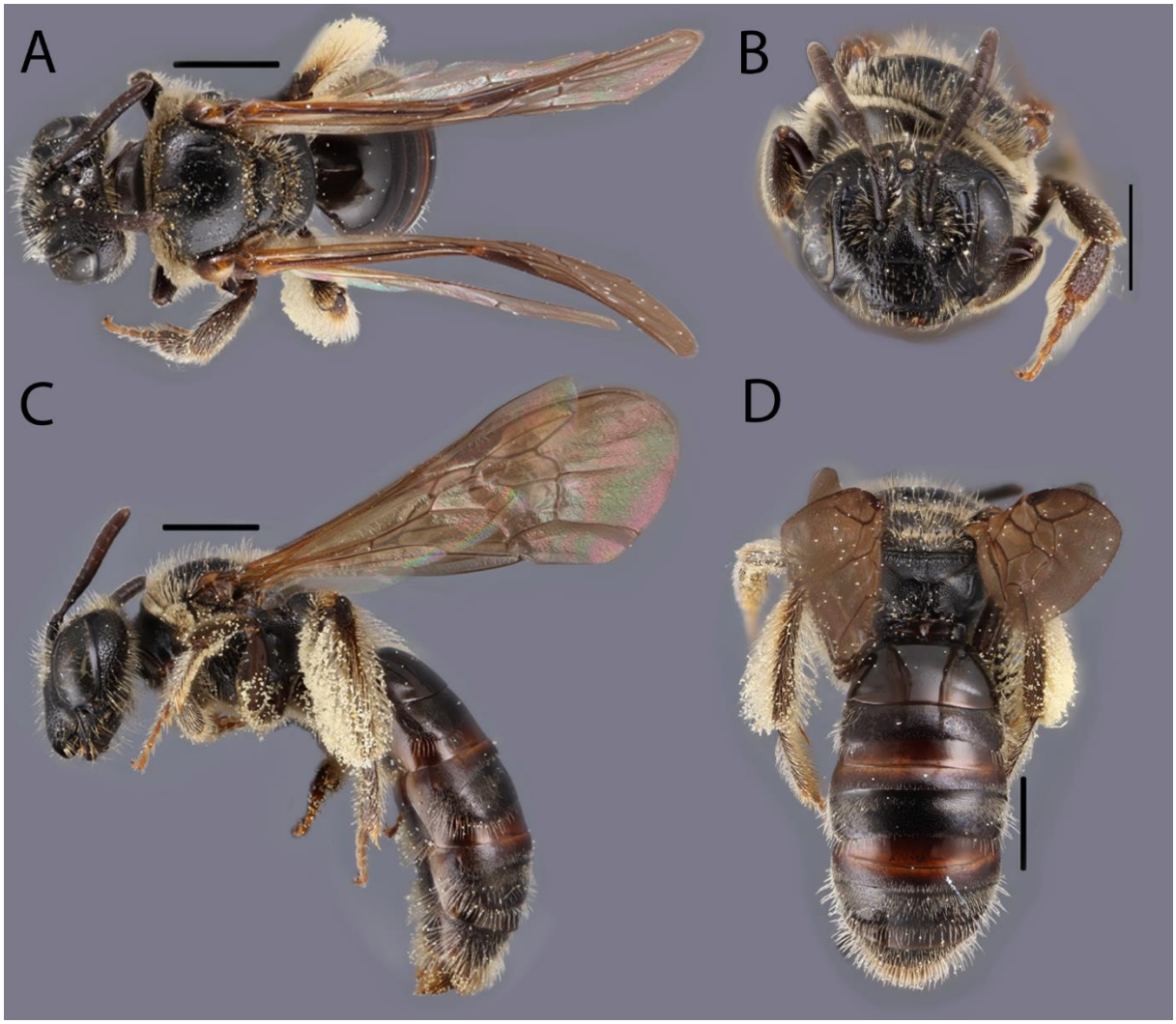


Figure 27. *Protandrena* (*Pterosarus*) *atricornis*, ♀. CUIC. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena atricornis* adults are active from mid-July to late September. Most floral records are from the tribe Astereae, with preference for the genus *Erigeron*.

Range: Mexico (Michoacán), USA (Arizona, Colorado, New Mexico).

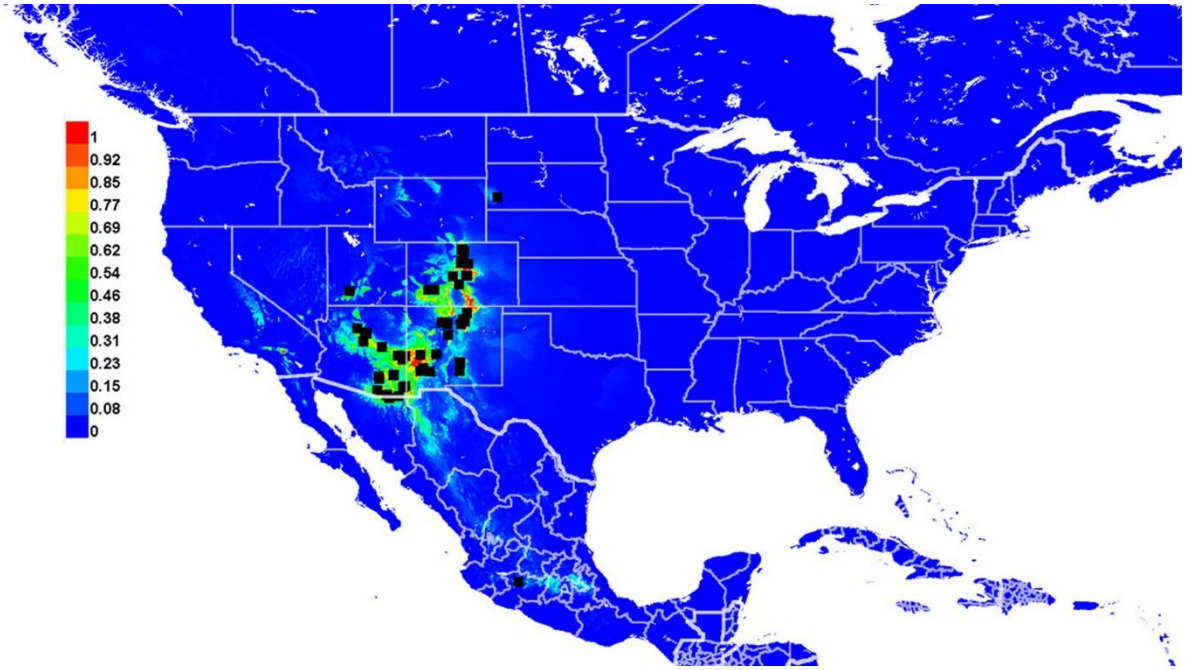


Figure 28. Georeferenced collection records of *Protandrena* (*Pterosarus*) *atricornis* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *aurifodinae* (Michener)**

(Figure 29)

Pseudopanurgus aurifodinae Michener, 1937: 320. ♂. Holotype ♂ CAS: 8772. Type locality: USA; California: Gold Mountain: 27 Aug 1932. Examined specimen.

Type specimens: Michener (1937) described the *Pseudopanurgus aurifodinae* from a single male specimen.

Diagnosis

Males of *Pr*. (*Pt*.) *aurifodinae* can be recognized by their full yellow maculations on the face that extend past antennal sockets laterally (contrast all except: *Pr. bilobata*, Pr. *boylei*, and *Pr. skeggox*), and dark pronotal lobes (contrast remaining).

Material examined:

USA – **California** • 1 holotype ♂; San Bernadino, San Bernadino Mountains, Gold Mountain; [34.2880° N, 116.8391° W]; 27 Aug. 1932; Michener C.D. leg.; CAS

Description

Male:

Structure: Head broader than long. Face below antennae convex. Labral process trapezoidal, broader than long, apex emarginate. Clypeus without median impressed line. Compound eyes convergent below. Posterior ocelli 0.26 mm apart. Flagellomeres distinctly longer than broad. Dorsal pronotal carina absent. Prosternum not produced. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 triangular. S6 notch shallow, less than 1/3 of disk, lateral carina absent.

Sculpture: Clypeus punctation coarse and dense (IS = 0.5 – 1 PD). Paraocular punctation fine and dense medially (IS < 1 PD) sparser laterally (IS = 1 – 4 PD). Supraclypeal area punctation fine and dense (IS < 1 PD). Fovea clavate. Foveae slightly convergent above, narrow end terminating 1 MOD from dorsal tangent of antennal socket. Frons punctation reticulate. Vertex punctation fine and dense (IS < 1 PD). Mesoscutum punctation fine and dense (IS < 1 PD). Scutellum punctation coarse and dense (IS < 1 PD) reticulate medially. Mesopleuron punctation coarse and dense (IS < 1 PD). Lateral propodeum punctation reticulate. Posterior propodeum

punctation reticulate. Posterior propodeum imbricate. Dorsal face of T1 punctation coarse and dense (IS < 1 PD) sparser medially (IS = 1). T2 basal impression deep, approximately 2/3 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation sparse (IS = 1 PD).

Colour: Clypeus yellow. Supraclypeal area yellow terminates ~0.5 MOD from antennal socket. Lower paraocular area yellow to within 1 puncture distance of antennal socket medially and extending 1 MOD past antennal socket along compound eye. Labral process yellow. Mandible yellow. Scape black. Flagellomeres dark. Pronotal lobe black. Tegula brown. Wing veins and stigma brown, membrane hyaline. Fore, mid and hind tibia almost entirely yellow with only a reduced dark spot posteriorly. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, yellow. Scutellum pilosity long, yellow. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium length, sparse. S4 pubescence medium length, dense, with medially directed apicolateral fringes. S5 pubescence long, medially directed apicolateral fringes.

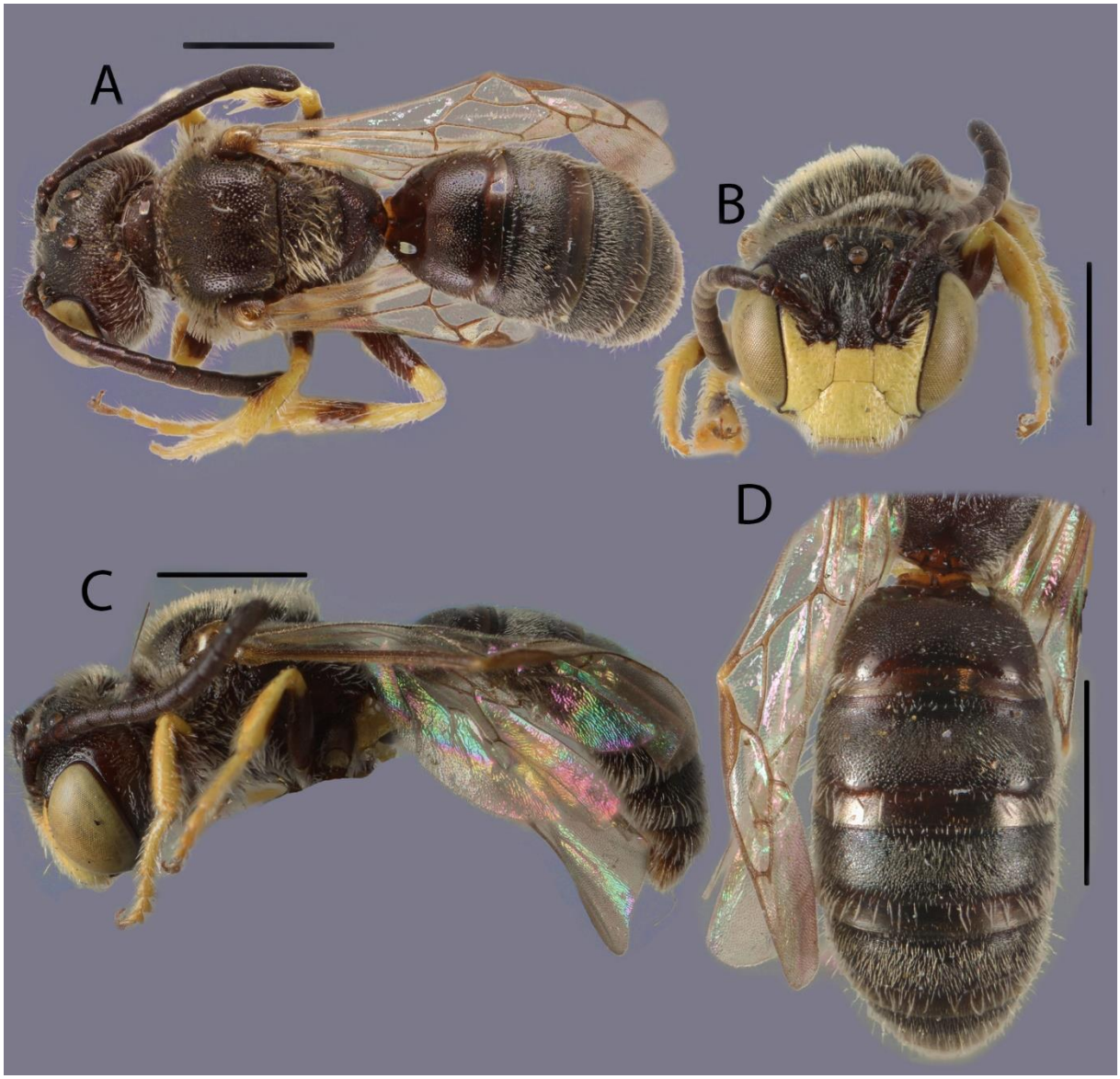


Figure 29. *Protandrena* (*Pterosarus*) *aurifodinae*, ♂. Holotype. CAS: 8772. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Range. USA (southern California).

***Protandrena* (*Pterosarus*) *barberi* (Cockerell)**

(Figure 30, Figure 31)

Panurginus barberi Cockerell, 1899: 129. ♂. Syntype ♂ NMNH: 533791. Type locality: USA; New Mexico: Mescalero: 12 Jul 1898. Examined by photos.

Type specimens: Cockerell (1899) described *Panurginus barberi* based on an unknown number of males. I select specimen 533791 at the NMNH as the lectotype.

Diagnosis:

Males of *Pr*. (*Pt*.) *barberi* can be recognized by a combination of their non-macrosculptured posterior face of propodeum (contrast all except: *Pr. bidentis*, *Pr. illustris*, *Pr. irregularis*, *Pr. labrosa*, *Pr. perlaevis*), yellow pronotal lobes (contrast *Pr. bidentis*, *Pr. illustris*, *Pr. irregularis*), and dark flagella (contrast remaining).

Females of *Pr*. (*Pt*.) *barberi* can be recognized by their non-macrosculptured posterior face of propodeum (contrast all except: *Pr. amor*, *Pr. albertensis*, *Pr. andrenoides*, *Pr. bidentis dracomons*, *Pr. illustris*, *Pr. irregularis*, *Pr. labrosa*, *Pr. perlaevis*, *Pr. piercei*), yellow pronotal lobes (contrast *Pr. albertensis*, *Pr. andrenoides*, *Pr. bidentis*, *Pr. dracomons*, *Pr. illustris*, *Pr. irregularis*, *Pr. piercei*), and forked labral process (contrast *Pr. amor*, *Pr. labrosa*).

Material examined:

MEXICO – **Chiapas** • 3♂♂; Ocosingo, Shanil (52.9 km N), near Agua Azul; 17.2167° N, 92.1° W; elev. 320 m.; 23 Apr. 1993; LaBerge W.E. leg.; INHS – **Chihuahua** • 1♀, 1♂♂; Cuauhtemoc, Cuauhtemoc (14 km W); [28.367° N, 107.0246° W]; 19 Aug. 1991; Ayala R. leg.; INHS • 1♀; Cuauhtemoc, Cuauhtemoc (16 km S); [28.2585° N, 106.877° W]; 19 Jul. 1991; Neff J.L. leg.; INHS – **Guerrero** • 1♀; Chilpancingo (5.2 mi E); [17.5511° N, 99.4316° W]; elev. 1737 m.; 08 Aug. 1962; U Kansas Mexican Expedition leg.; SEMC– **Jalisco** • 1♀; Lagos de

Moreno (6 mi SE); [21.2946° N, 101.8641° W]; elev. 1798 m.; 27 Jul. 1962; U Kansas Mexican Expedition leg.; SEMC – **Oaxaca** • 1♀; Oaxaca; [17.0654° N, 96.7236° W]; elev. 1800 m.; 13 Jul. 1928; Lassmanu G. leg.; CUIC – **San Luis Potosi** • 1♂; Tamazunchale, Tamazunchale (5 mi. N); [21.3237° N, 98.8152° W]; 22 Dec. 1948; Ross E.S. leg.; CAS – **Sonora** • 1♀; Myacoba (10 km E); 18 Aug. 1991; Rozen J.G., Pember N. leg.; AMNH – **Tamaulipas** • 1♀; Antiguo Morelos (4.5 km W); [22.5557° N, 99.1289° W]; 17 Oct. 1985; Smith C.L. leg.; UGCA

USA – **Arizona** • 1♀; Cochise, Bisbee, 1429 Franklin Street; 31.4066° N, 109.9327° W; elev. 1585 m.; 17 Aug. 2012; Menke A.S. leg.; BBSL • 1♂; Cochise, Chiricahua Mountains; [31.9034° N, 109.2756° W]; 05 Sep. 1947; Knull D.J., J.N. leg.; OSUC • 1♂; same location as preceding; 12 Sep. 1947; Knull D.J., J.N. leg.; OSUC • 2♂♂; Cochise, Chiricahua Mountains, Rustler Park; [31.9034° N, 109.2756° W]; 01 Aug. 1996; Danforth B.N. leg.; CUIC • 2♂♂; Cochise, Coronado National Forest; 31.9086° N, 109.2511° W; 19 Aug. 2015; Brown R.L. leg.; MEM • 1♂; Cochise, Coronado National Forest; [31.863° N, 110.4024° W]; 14 Aug. 1974; Duffield R.M. leg.; UGCA • 1♂; Cochise, Huachuca Mountains, Miller Canyon; [31.2453° N, 110.1633° W]; elev. 2000-3000 m.; 17 Aug. 2000; Danforth B.N. leg.; ex *Salvia* sp.; CUIC • 1♂; same location as preceding; 05 Aug. 1952; Leech H.B., Green J.W. leg.; CAS • 1♀; Cochise, Huachuca Mountains, Miller Canyon; 31.4011° N, 110.3103° W; elev. 2520 m.; 17 Aug. 2000; Brooks R. leg.; SEMC • 1♀, 1♂; Cochise, Portal (12.6 mi. W); 31.997° N, 109.264° W; elev. 2310 m.; 01 Sep. 2014; Neff J.L. leg.; ex *Cosmos parviflorus*; CTMI • 1♀; Cochise, Portal, Paradise Junction; [31.9399° N, 109.2197° W]; 22 Aug. 2013; Wyman E.S. leg.; AMNH • 1♂; Cochise, Portal, Southwest Research Station; [31.884° N, 109.2061° W]; 17 Aug. 1972; Eickwort G., Eickwort K. leg.; CUIC • 1♂; same location as preceding; 04 Aug. 1972; Eickwort G., Eickwort K. leg.; CUIC • 4♂♂; same location as preceding; 21 Aug. 1959; Evans H.E. leg.;

CUIC • 1♂; same location as preceding; 30 Aug. 1959; Evans H.E. leg.; CUIC • 1♂; same location as preceding; 07 Aug. 1959; Evans H.E. leg.; CUIC • 2♂♂; same location as preceding; 15 Aug. 1959; Evans H.E. leg.; CUIC • 1♀, 2♂♂; Cochise, Portal, Southwest Research Station; 31.8852° N, 109.2051° W; 23 Aug. 2017; Oram R. leg.; RSKM • 1♀; same location as preceding; 24 Aug. 2017; Oram R. leg.; RSKM • 2♀♀, 2♂♂; Cochise, Portal, Southwest Research Station; [31.884° N, 109.2061° W]; elev. 1646 m.; 20 Jun. 1966; Rozen J.G., Rozen B.L. leg.; ex *Verbesina encelioides*; AMNH • 2♂♂; same location as preceding; 25 Aug. 2011; Ascher J.S., Wyman E.S leg.; AMNH • 2♂♂; same location as preceding; 25 Aug. 2014; Wyman E.S. leg.; AMNH • 1♂; same location as preceding; 26 Aug. 2008; Ascher J.S. leg.; AMNH • 1♂; same location as preceding; 29 Aug. 2009; Ascher J.S. leg.; AMNH • 1♂; same location as preceding; 16 Aug. 2001; Giles V. leg.; AMNH • 1♂; same location as preceding; 02 Sep. 1987; Tanner G. leg.; AMNH • 1♀; same location as preceding; 31 Aug. 2008; Ascher J.S. leg.; AMNH • 1♂; same location as preceding; 21 Aug. 2011; Wyman E.S. leg.; AMNH • 1♀; same location as preceding; 29 Aug. 2013; Soh Z. leg.; AMNH • 1♂; same location as preceding; 21 Aug. 2011; Ascher J.S., Wyman E.S leg.; AMNH • 1♀; same location as preceding; 16 Aug. 2001; Giles V. leg.; AMNH • 1♀; same location as preceding; 08 Sep. 1955; Gertsch, Ordway leg.; AMNH • 1♀; same location as preceding; 26 Aug. 1966; Rozen J.G., Rozen B.L. leg.; AMNH • 1♂; same location as preceding; 24 Aug. 1968; Rozen J.G., Favreau leg.; AMNH • 1♂; same location as preceding; 24 Aug. 1973; Favreau M. leg.; AMNH • 1♂; same location as preceding; 24 Aug. 1956; Ordway E. leg.; AMNH • 3♂♂; same location as preceding; 21 Aug. 1959; Evans H.E. leg.; CUIC • 1♀; Cochise, Portal, Southwest Research Station (8km N); 31.9039° N, 109.295° W; elev. 1620 m.; 27 Aug. 2000; Brooks R. leg.; SEMC • 1♂; Cochise, Southwest Research Station, 5 mi. W of Portal; [31.884° N, 109.2061° W]; elev.

1646 m.; 16 Sep. 1966; Arnaud P.H. leg.; CAS • 2♀♀; Cochise , Portal (5 mi. W); [31.9148° N, 109.2243° W]; elev. 1646 m.; 20 Jun. 1966; Rozen J.G., Rozen B.L. leg.; AMNH • 1♂; Cochise , Willcox (4 mi. E); [32.2524° N, 109.865° W]; 24 Aug. 2011; Cusser S. leg.; WRME • 1♂; Santa Cruz, Patagonia; [31.5395° N, 110.7562° W]; 09 Aug. 1940; Ross E.S. leg.; CAS • 1♀; Santa Cruz, Santa Rita Mountains, Madera Canyon; [31.7251° N, 110.8801° W]; 20 Aug. 1969; Rozen J.G., Rozen B.L. leg.; AMNH • 1♀; Santa Cruz, Sonoita (25 mi. E); [31.7242° N, 110.212° W]; 09 Aug. 1924; Van Duzee E.P. leg.; CAS – **New Mexico** • 1♂; Otero, Mescalero; [33.1576° N, 105.7742° W]; 12 Jul. 1898; Cockerell T.D.A. leg.; USNM • 1♀; Otero, Mountain Park (3 mi. W); [32.9465° N, 105.8772° W]; 25 Aug. 1951; Kessel E.L. leg.; CAS – **Texas** • 1♂; Jeff Davis, Davis Mountains; [30.7501° N, 104.0838° W]; 12 Aug. 1962; Triplehorn C.A., W.E. leg.; OSUC • 1♀, 1♂; Travis, Austin, BFL; 30.285° N, 97.731° W; 21 Oct. 2018; Neff J.L. leg.; ex *Verbesina virginica*; CTMI

Description

Male:

Structure: Body length range 4.9–6.1 mm. Head broader than long (HL/HW ratio 0.98). Face below antennae convex. Labral process forked, broader than long, apex emarginate. Clypeus with median impressed line. Compound eyes convergent below (UOD/LOD ratio 1.17). Posterior ocelli 0.25 mm apart. Flagellomeres about equal in length and width. Dorsal pronotal carina extends laterally to pronotal lobes. Prosternum not produced. ITD 1.1 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.11 mm. S6 notch shallow only 1/3, lateral carina absent.

Sculpture: Clypeus punctation coarse and dense (IS < 1 PD). Paraocular punctation coarse and dense (IS = 0.5 PD). Supraclypeal area punctation coarse and dense (IS < 1 PD). Fovea clavate. Foveae converging above, narrow end terminating in line with antennal socket. Frons coarsely reticulate. Vertex punctation fine and dense (IS < 1 PD). Mesoscutum punctation finely reticulate anteriorly, sparser posteriorly (IS > 1 PD). Scutellum punctation coarse and dense (IS < 1 PD). Mesopleuron punctation coarse and dense (IS < 1 PD). Lateral propodeum finely reticulate. Posterior propodeum punctation absent. Posterior propodeum tessellate. Dorsal face of T1 punctation fine and sparse (IS > 2 PD). T2 basal impression shallow, approximately basal ¼ of T2 impunctate. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus yellow with two black dots. Supraclypeal area black. Lower paraocular area yellow extending along margin of compound eye terminating in line with ventral tangent of antennal socket. Labral process yellow. Mandible yellow. Scape black. Flagellomeres dark. Pronotal lobe yellow. Tegula light brown. Wing veins and stigma dark, membrane smoky. Fore tibia yellow anteriorly dark posteriorly, mid and hind tibia yellow at knee. Tarsi 2 – 4 dark, basitarsus yellow.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity medium-length, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium length, dense. S4 pubescence medium length, dense. S5 pubescence long, medially directed apicolateral fringes.

Female:

Structure: Body length range 5.58–6.85 mm. Head broader than long (HL/HW ratio 0.91). Face below antennae convex. Labral process forked, broader than long, apex emarginate. Clypeus

without median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.01). Posterior ocelli 0.26 mm apart. Flagellomeres broader than long. Dorsal pronotal carina extends laterally to pronotal lobes. Prosternum not produced. ITD 1.36 mm. Metapostnotum weakly extended medially <25% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.067 mm.

Sculpture: Clypeus punctation coarse and dense (IS < 1 PD). Paraocular punctation fine and dense (IS < 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea clavate. Foveae converging above, narrow end terminating ¾ way down antennal socket. Frons punctation fine and dense (IS < 1 PD). Vertex punctation fine and dense (IS < 1 PD). Mesoscutum punctation fine and dense anteriorly (IS < 1 PD) sparser posteriorly (IS > 1 PD). Scutellum punctation fine and dense (IS < 1 PD). Mesopleuron punctation fine and sparse (IS > 1 PD). Lateral propodeum punctation fine and sparse (IS = 1 PD). Posterior propodeum punctation absent. Posterior propodeum tessellate. Dorsal face of T1 punctation fine and sparse (IS > 2 PD). T2 basal impression shallow, approximately 1/4 of T2 lineolate basally. T3 punctation sparse (IS > 1 PD). T4 punctation sparse (IS > 1 PD).

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres dark. Pronotal lobe yellow. Tegula light brown. Wing veins light brown, stigma dark, membrane hyaline. Fore and mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity medium-length, white. Mesopleuron pilosity medium-length, white. Sternite pubescence colour white. S3 pubescence

medium length, sparse. S4 pubescence medium length, sparse. S5 pubescence medium length, sparse.

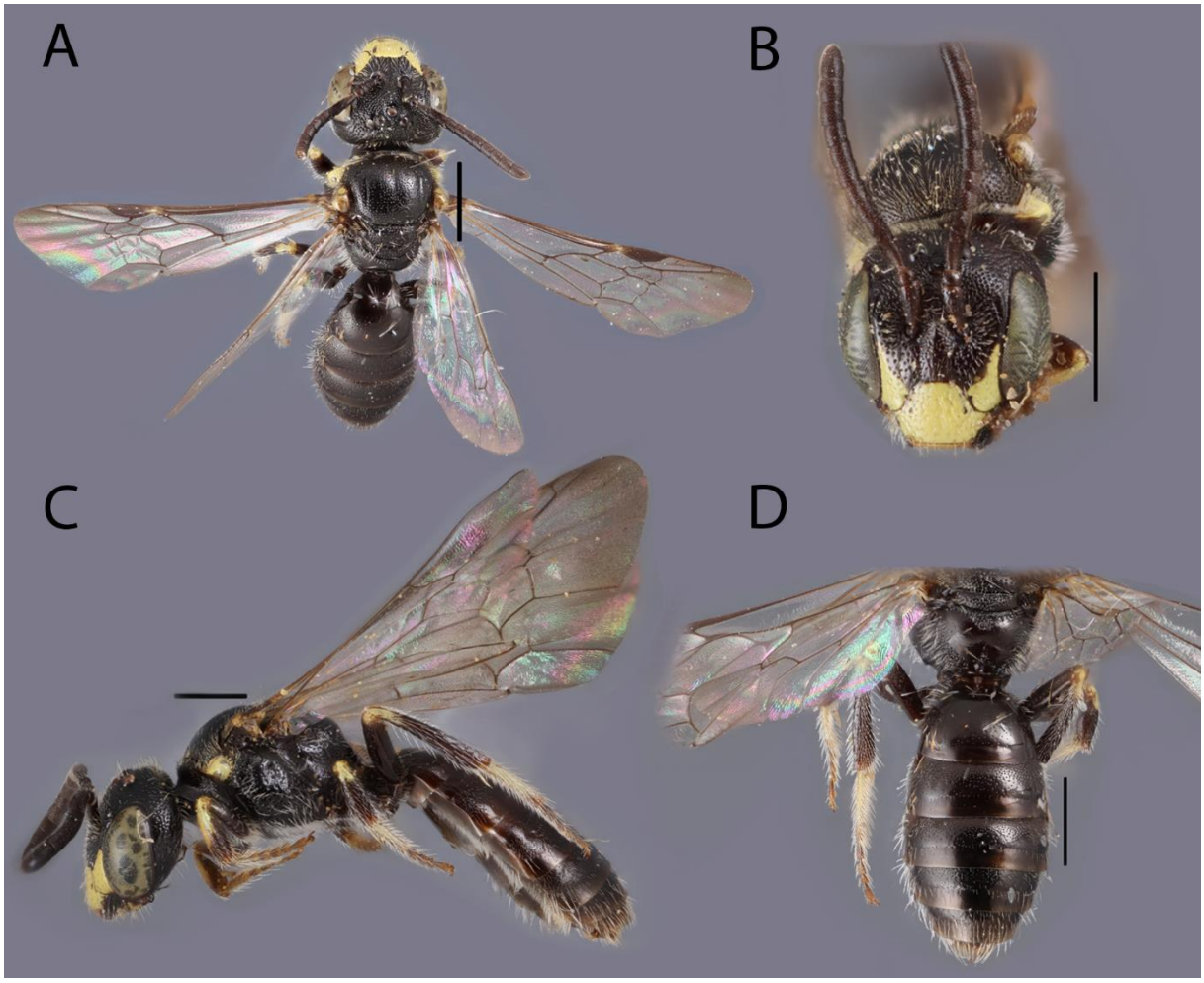


Figure 30. Protandrena (*Pterosarus*) *barberi*, ♂. AMNH_00027470. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

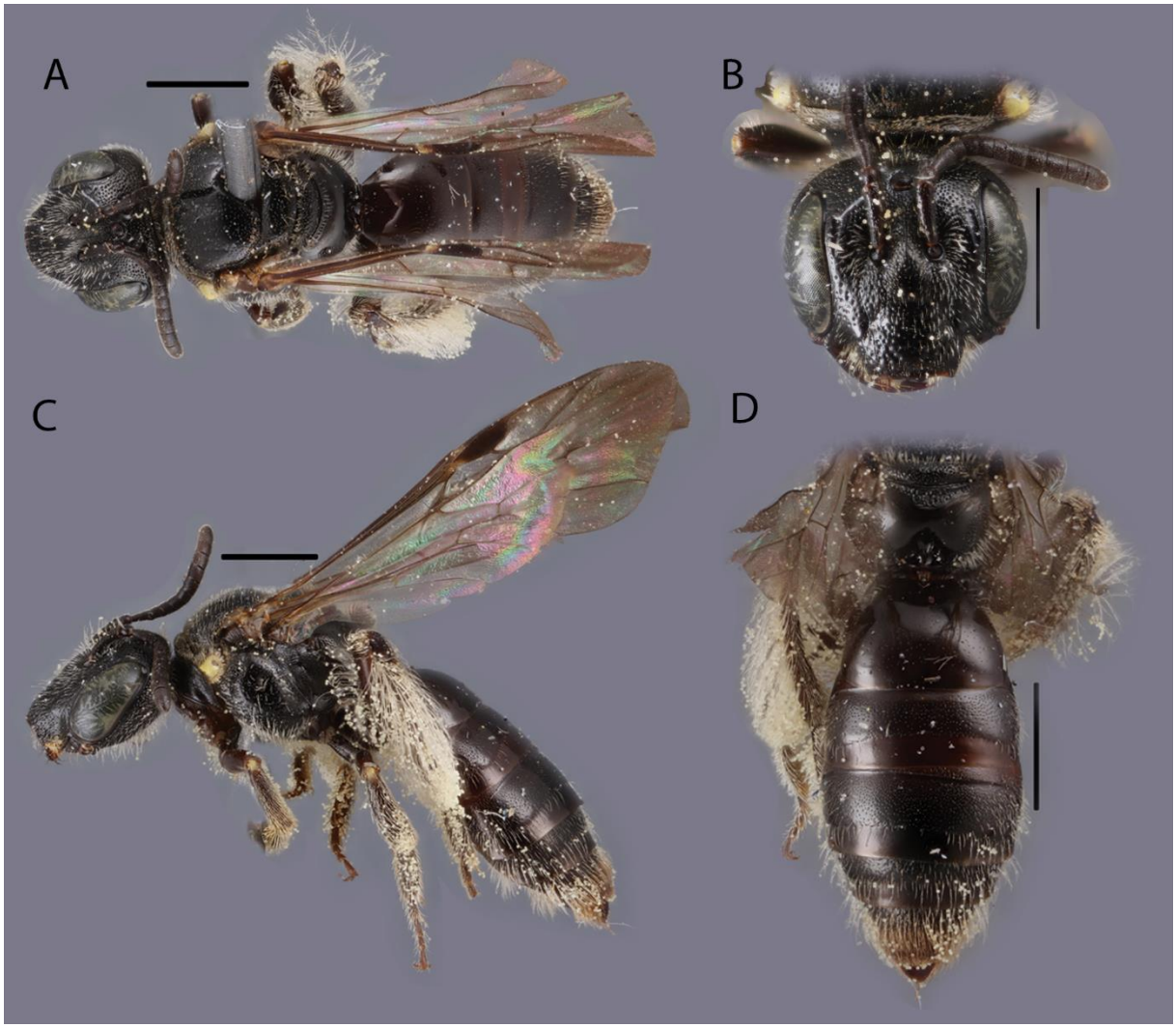


Figure 31. *Protandrena* (*Pterosarus*) *barberi*, ♀. AMNH_00291928. A. Dorsal habitus. B. Face. C. Lateral habitus. D. Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena barberi* has a broad flight period across its range and is active from late June to late October (with one record from December in the southern extent of it's range). Floral records for the species are poor with only 15 available, from these there appears to be a preference for the tribe Heliantheae with preference for the genus *Verbesina*.

Range: Mexico (Chiapas, Chihuahua, Jalisco, Oaxaca, San Luis Potosi, Sonora, Tamaulipas), USA (Arizona, New Mexico).

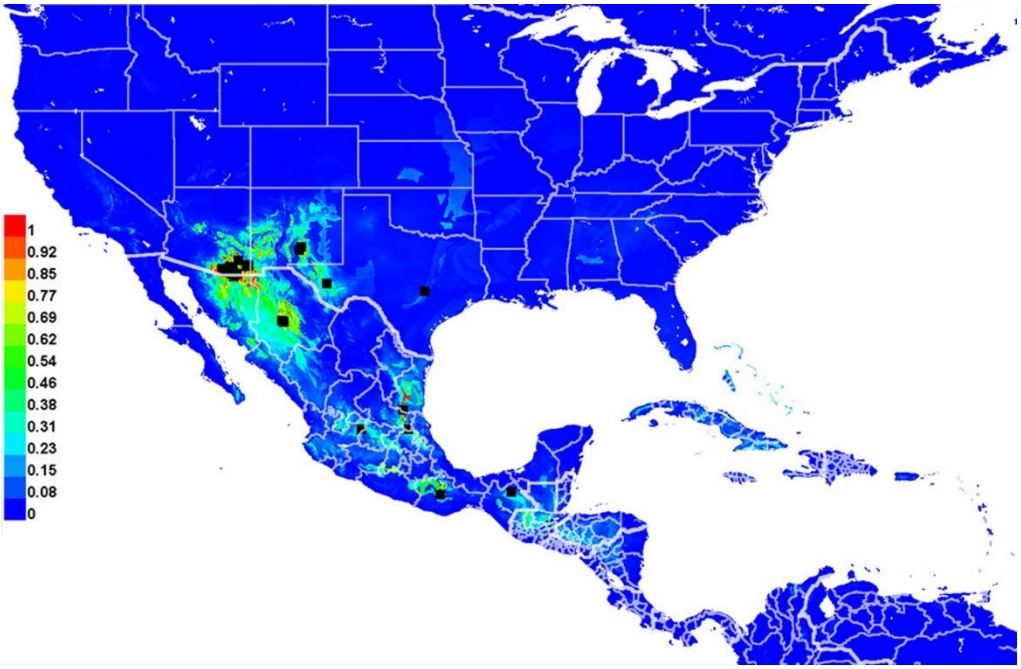


Figure 32. Georeferenced collection records of *Protandrena* (*Pterosarus*) *barberi* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *bidentis* (Cockerell)**

(Figure 33, Figure 34)

Calliopsis bidentis Cockerell, 1896: 283. ♀♂. Syntype ♀ NMNH: 533803. Type locality: Mexico; Veracruz: San Rafael. 14 Mar 1896. Examined by photos.

Panurginus costaricensis Friese, 1916: 321–322. Type locality: Costa Rica; San Jose: June-1915 Not examined

Type specimens: Cockerell (1896) described *Calliopsis bidentis* from three male and five female syntypes. I select specimen 533803 as the lectotype. Friese (1916) described *Panurginus costaricensis* from one male and five female syntypes.

Diagnosis:

Males of *Pr*. (*Pt*.) *bidentis* can be recognized by a combination of their non-macrosculptured posterior face of propodeum (contrast all except: *Pr. barberi*, *Pr. illustris*, *Pr. irregularis*, *Pr. labrosa*, *Pr. perlaevis*), dark pronotal lobes (contrast *Pr. barberi*, *Pr. labrosa*, *Pr. perlaevis*), and finely reticulate scutum punctures anteriorly (contrast remaining).

Females of *Pr*. (*Pt*.) *bidentis* can be recognized by their non-macrosculptured posterior face of propodeum (contrast all except: *Pr. amor*, *Pr. albertensis*, *Pr. andrenoides*, *Pr. barberi dracomons*, *Pr. illustris*, *Pr. irregularis*, *Pr. labrosa*, *Pr. perlaevis*, *Pr. piercei*), dark pronotal lobes (contrast *Pr. amor, Pr. barberi, Pr. labrosa*), and forked labral process (contrast remaining).

Material examined:

BELIZE – **Cayo** • 1♀; Pooks Hill Lodge; 17.154833° N, 88.850833° W; 03 Oct. 2018; Delphia C.M., Runyon J.B. leg.; MTEC

MEXICO – **Jalisco** • 1♀; Mazamitla (7 km W); [19.9213° N, 103.0885° W]; 06 Oct. 1992; Turnbow R. leg.; UGCA– **Mexico City** • 1♀; Mexico City; [19.3905° N, 99.4238° W]; elev. 2300 m.; 05 Aug. 1928; Lassmanu G. leg.; CUIC– **San Luis Potosi** • 1♀; Tamazunchale, Tamazunchale; [21.2599° N, 98.7894° W]; 04 Jan. 1941; Bohart G.E. leg.; CAS– **Vera-Cruz** • 1♀; San Rafael; [20.1886° N, 96.8674° W]; 14 Mar. 1896; Townsend C.H.T. leg.; USNM

USA – **Arizona** • 1♂; Cochise, Portal (1 mi. E) Foothills Road at Cave Creek; [31.9143° N, 109.1287° W]; 27 Aug. 2008; Ascher J.S. leg.; AMNH • 1♂; Cochise, Portal, Southwest Research Station; [31.884° N, 109.2061° W]; elev. 1646 m.; 09 Sep. 1959; Evans H.E. leg.; CUIC

Description

Male:

Structure: Body length range 6.25–6.4 mm. Head broader than long (HL/HW ratio 0.95). Face below antennae convex. Labral process triangular, longer than broad, apex emarginate. Clypeus with median impressed line. Compound eyes convergent below (UOD/LOD ratio 1.16). Posterior ocelli 0.25 mm apart. Flagellomeres longer than broad. Dorsal pronotal carina absent. Prosternum not produced. ITD 0.0875 mm. Metapostnotum not extended medially. Tarsi 2–4 triangular. Fore tarsi width 1.16 mm. S6 notch deep, extending approximately½ of disk, lateral carina absent.

Sculpture: Clypeus punctation fine and sparse (IS = 1). Paraocular punctation fine and sparse (IS = 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea ovate. Foveae slightly converging above, posterior end terminating 1 MOD from dorsal tangent of antennal socket. Frons finely reticulate. Vertex punctation fine and dense (IS < 1 PD). Mesoscutum punctation finely reticulate anteriorly, sparser posteriorly (IS < 1 PD). Scutellum punctation coarse and dense (IS < 1 PD). Mesopleuron punctation coarse and dense (IS < 1 PD). Lateral propodeum finely reticulate. Posterior propodeum punctation absent. Posterior propodeum tessellate. Dorsal face of T1 punctation fine and sparse (IS > 2 PD). T2 basal impression deep, approximately 1/3 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation sparse (IS = 1 PD).

Colour: Clypeus yellow. Supraclypeal area with reduced yellow spot 1 MOD in diameter. Lower paraocular area yellow extending along margin of compound eye terminating in line with ventral tangent of antennal socket. Labral process black. Mandible black. Scape black. Flagellomeres F2-F8 yellow ventrally. Pronotal lobe black. Tegula brown. Wing veins and stigma brown, membrane smoky. Fore tibia yellow anteriorly dark posteriorly, mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity medium-length, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium length, dense. S4 pubescence medium length, dense. S5 pubescence long, medially directed apicolateral fringes.

Female:

Female: Structure: Body length range 6.47–6.82 mm. Head broader than long (HL/HW ratio 0.89). Face below antennae convex. Labral process forked, longer than broad, apex emarginate. Clypeus without median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.02). Posterior ocelli 0.27 mm apart. Flagellomeres broader than long. Dorsal pronotal carina extend laterally to pronotal lobes. Prosternum not produced. ITD 1.43 mm. Metapostnotum weakly extended medially <25% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.069 mm.

Sculpture: Clypeus punctation coarse and dense (IS < 1 PD). Paraocular punctation coarse and dense (IS < 1 PD). Supraclypeal area punctation fine and sparse (IS = 1 PD). Fovea ovate. Foveae converging above, posterior end terminating ½ way down antennal socket. Frons finely reticulate. Vertex punctation fine and dense (IS < 1 PD). Mesoscutum punctation finely reticulate

anteriorly, sparser posteriorly (IS = 1 PD). Scutellum punctation fine and sparse (IS = 1 PD). Mesopleuron punctation fine and sparse (IS > 1 PD). Lateral propodeum punctation fine and dense (IS < 1 PD). Posterior propodeum punctation absent. Posterior propodeum not microsculptured. Dorsal face of T1 punctation very fine and sparse (IS > 3 PD). T2 basal impression shallow, approximately basa ¼ of T2 impunctate. T3 punctation sparse (IS > 1 PD). T4 punctation sparse (IS > 1 PD).

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F4-F8 orange ventrally. Pronotal lobe black. Tegula brown. Wing veins and stigma brown, membrane smoky. Fore tibia yellow at knee, remaining tibia entirely black. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity medium-length, white. Mesopleuron pilosity medium-length, white. Sternite pubescence colour white. S3 pubescence medium length, sparse. S4 pubescence medium length, sparse. S5 pubescence long, medially directed apicolateral fringes.

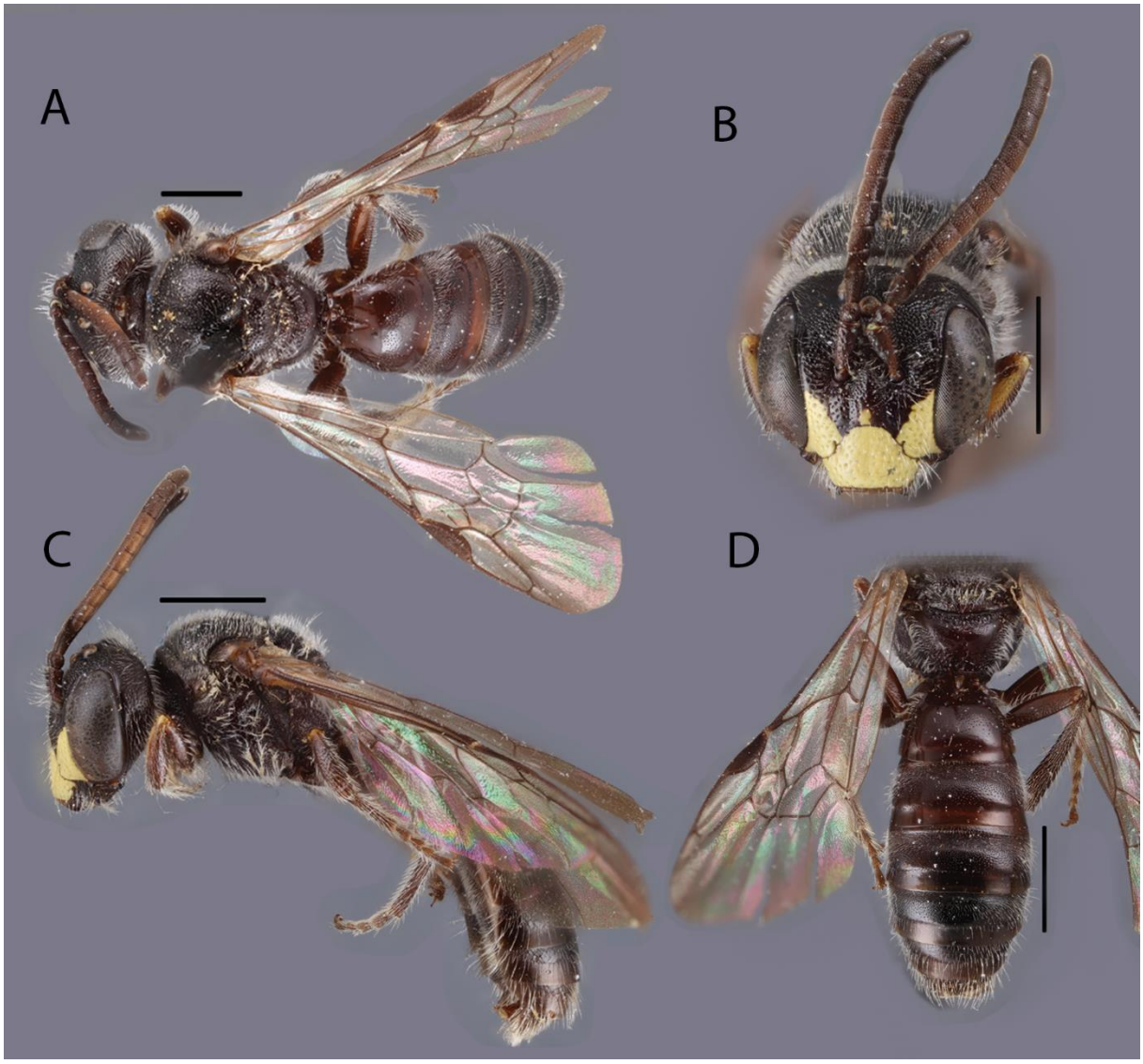


Figure 33. *Protandrena* (*Pterosarus*) *bidentis*, ♂. CUIC. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

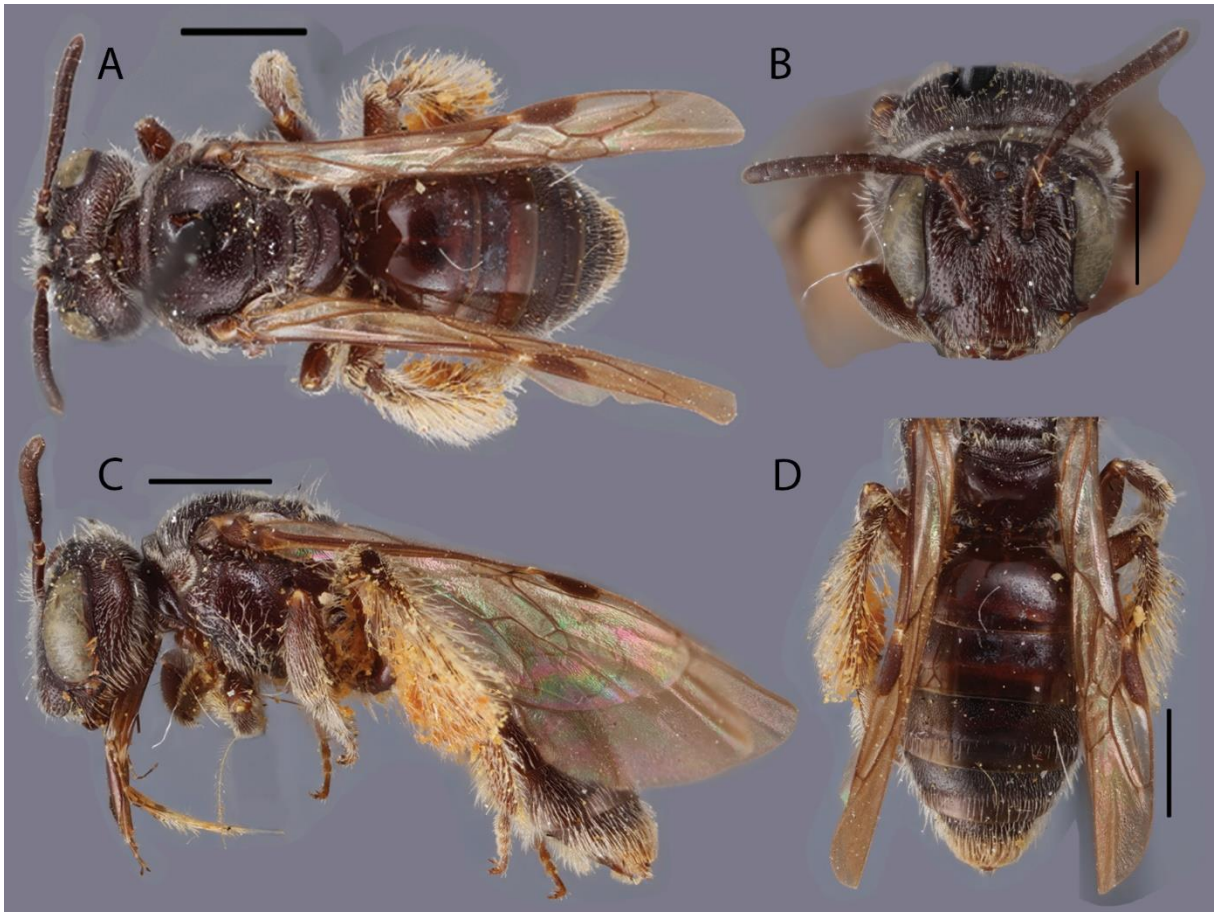


Figure 34. *Protandrena* (*Pterosarus*) *bidentis*, ♀. CUIC. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena bidentis* is active from March to September (with one record as early as January). Literature records are found throughout Mexico and South America. However, examination of specimens identified as *Pr. bidentis*, and those with a bidentate labral process found throughout Mexico alone have shown great diversity and several distinct morphotypes. It is likely that many Mexican and Central American records consist of different undescribed species other than *Pr. bidentis*.

Range: Belize (Cayo), Mexico (Guerrero, Jalisco, Mexico City, San Luis Potosi, Vera-Cruz), USA (Arizona), Costa Rica.

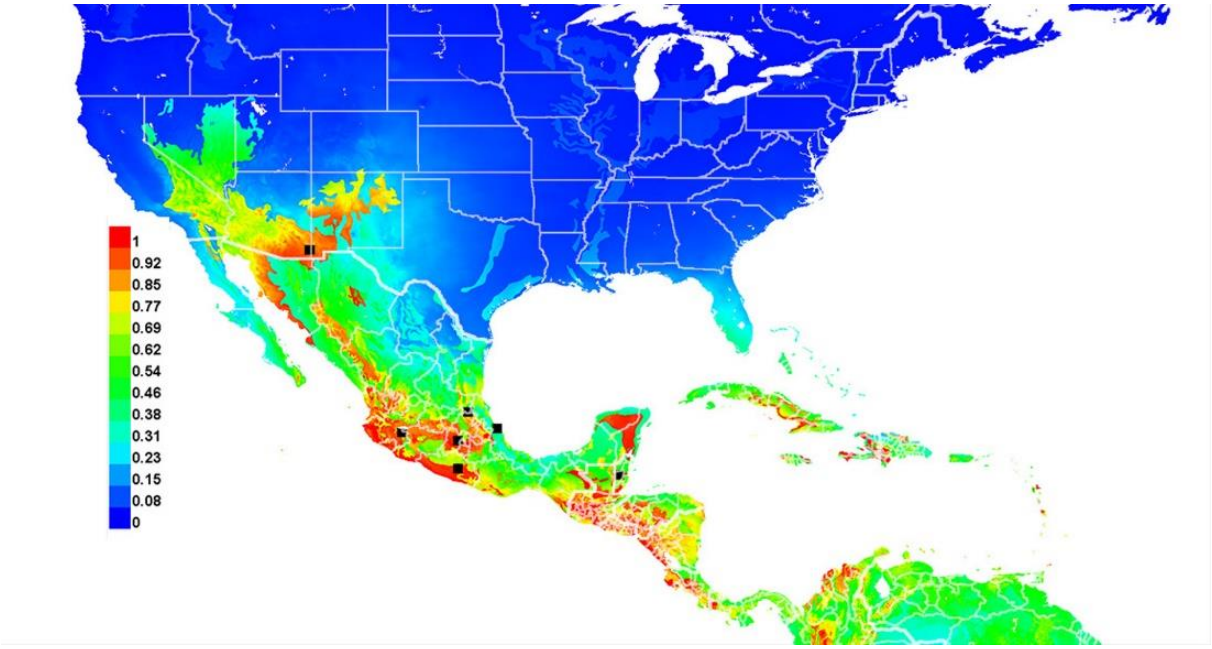


Figure 35. Georeferenced collection records of Protandrena (Pterosarus) bidentis (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *bilobata* new species**

(Figure 36)

Holotype: ♂ Mexico – Chihuahua • Jiminez, Jiminez (40 km SE); [26.9256° N, 104.594° W]; 26 Aug. 1991; Rozen J.G. leg.; AMNH. AMNH_IZC00292077

Diagnosis:

Males of *Pr*. (*Pt*.) *bilobata* can be recognized by their facial maculations that extend past antennae (contrast all except: *Pr*. *aurifodinae*, *Pr. boylei*, *Pr*. *skeggox*), triangular tarsi (contrast *Pr. boylei*, *Pr*. *skeggox*) and yellow pronotal lobes (contrast *Pr*. *aurifodinae*).

Etymology:

A noun in apposition from the Latin “bi” (‘two’) and “lobus” (‘lobed’) in reference to the lobe shaped lateral markings of the face.

Material examined:

MEXICO – **Chihuahua** • 1♂; Jiminez, Jiminez (40 km SE); [26.9256° N, 104.594° W]; 26 Aug. 1991; Rozen J.G. leg.; AMNH

USA – **New Mexico** • 1♂; Hidalgo, Roadforks; [32.2305° N, 108.9584° W]; 06 Sep. 1987; Rozen J.G., Rozen B.L. leg.; AMNH

Description

Male:

Structure: Body length range 4.73–5.17 mm. Head broader than long (HL/HW ratio 0.85). Face below antennae convex. Labral process trapezoidal, broader than long, apex truncate. Clypeus without median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.25). Posterior ocelli 0.23 mm apart. Flagellomeres longer than broad. Dorsal pronotal carina absent. Prosternum not produced. ITD 0.81 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.11 mm. S6 notch shallow, less than 1/3 of disk, lateral carina absent.

Sculpture: Clypeus punctation fine and dense (IS < 1 PD). Paraocular punctation fine and sparse (IS = 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea ovate. Foveae converging above, ventral tangent 1 MOD from dorsal tangent of antennal socket. Frons punctation fine and dense (IS < 1 PD). Vertex punctation fine and dense (IS < 1 PD). Mesoscutum punctation fine and dense (IS < 1 PD). Scutellum punctation fine and dense (IS < 1 PD). Mesopleuron punctation fine and sparse (IS = 1 PD). Lateral propodeum finely reticulate. Posterior propodeum finely reticulate. Posterior propodeum tessellate. Dorsal face of T1 punctation fine and dense (IS < 1 PD). T2 basal impression deep, approximately 1/2 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus yellow. Supraclypeal area yellow to within 0.5 MOD of antennal socket. Lower paraocular area yellow reaching ventral tangent of antennal socket medially extending along margin of compound eyes in a broadly rectangular shape terminating 0.5 MOD above dorsal tangent of antennal socket. Labral process yellow. Mandible yellow. Scape yellow anteriorly. Flagellomeres F1-F9 yellow ventrally. Pronotal lobe yellow. Tegula brown. Wing veins and stigma brown, membrane hyaline. Fore tibia yellow anteriorly dark posteriorly, mid and hind tibia yellow posteriorly, apically, and basally dark medially and anteriorly. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, yellow. Scutellum pilosity medium-length, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium-length, sparse. S4 pubescence medium-length, sparse. S5 pubescence long, medially directed apicolateral fringes.

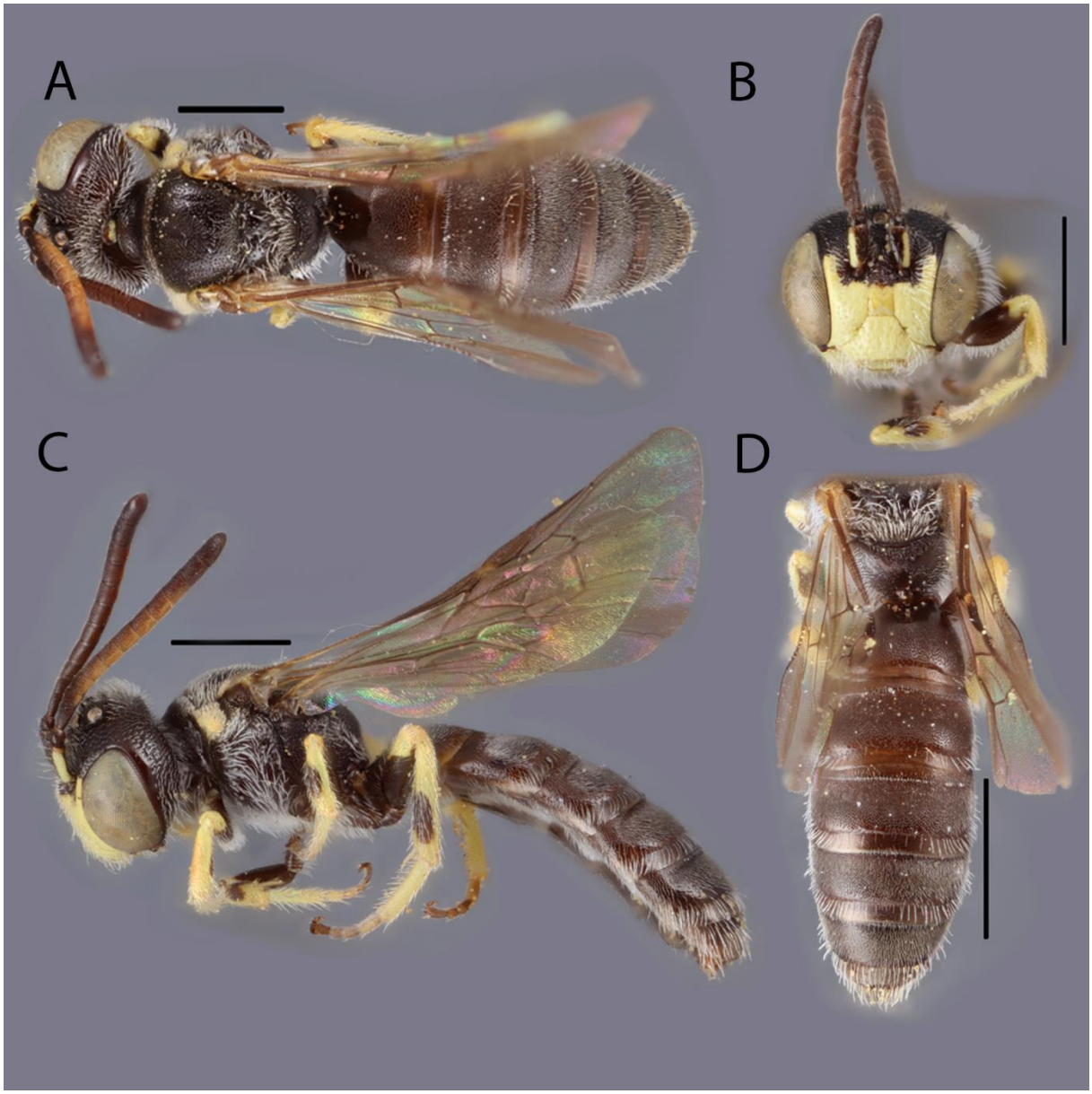


Figure 36. *Protandrena* (*Pterosarus*) *bilobata*, ♂. AMNH_IZC00292077. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

***Protandrena* (*Pterosarus*) *boylei* (Cockerell)**

(Figure 37)

Calliopsis Boylei Cockerell, 1896b: 161. ♂. Holotype ♂ NMNH: 533802. Type locality: USA; New Mexico: Santa Fe: 2 Aug 1895.

Taxonomy: Cockerell, 1897: 350. – Crawford, 1912: 368 (tax. characters). – Rozen, 1966: 6–7, figs. 1–7 (larva).

Type specimens: Cockerell (1896b) described *Calliopsis boylei* from a single male collected by V. Boyle on *Cleome* (Cleomaceae).

Diagnosis:

Males of *Pr*. (*Pt*.) *boylei* can be recognized by their yellow facial maculations extending past antennal sockets (contrast all except: *Pr. aurifodinae*, *Pr. bilobata*, and *Pr. skeggox*), inflated tarsi (contrast *Pr. aurifodinae*, *Pr. bilobata*), and dense scutum punctures (contrast *Pr. skeggox*).

Material examined:

USA – **Colorado** • 10♂♂; Adams, Aurora; [39.7294° N, 104.8319° W]; 23 Aug. 1989; Eickwort G.C. leg.; CUIC • 1♂; Fremont, Coaldale; [38.3656° N, 105.7578° W]; 01 Aug. 1958; Shinn A.F. leg.; SEMC– **New Mexico** • 1♂; Santa Fe, Santa Fe; [35.687° N, 105.9378° W]; 02 Aug. 1895; Boyle leg.; USNM

Description:

Male:

Structure: Body length range 6–6.67 mm. Head broader than long (HL/HW ratio 0.88). Face below antennae flat. Labral process trapezoidal, broader than long, apex emarginate. Clypeus without median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio

1.22). Posterior ocelli 0.32 mm apart. Flagellomeres longer than broad. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.15 mm. Metapostnotum strongly extended medially >50% way to propodeal pit. Tarsi 2–4 inflated. Fore tarsi width 0.1925 mm. S6 notch deep, extending approximately 1/2 of disk, lateral carina absent.

Sculpture: Clypeus punctation fine and sparse medially (IS > 4 PD) denser laterally (IS < 1 PD). Paraocular punctation coarse and dense (IS < 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea ovate. Foveae converging above, narrow end terminating 0.5 MOD from dorsal tangent of antennal socket. Frons coarsely reticulate. Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation coarsely reticulate anteriorly sparser posteriorly (IS < 1 PD). Scutellum punctation coarse and sparse laterally (IS > 1 PD) denser medially (IS < 1 PD). Mesopleuron punctation coarse and dense (IS < 1 PD). Lateral propodeum punctation rugose. Posterior propodeum coarsely reticulate. Posterior propodeum tessellate. Dorsal face of T1 punctation fine and dense (IS < 1 PD) impunctate medially. T2 basal impression deep, approximately 1/2 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus yellow. Supraclypeal area yellow to within 0.5 MOD of antennal socket. Lower paraocular area yellow medially in line with ventral tangent of antennal sockets, extending along margin of compound eye, terminating in line with dorsal tangent of antennal socket. Labral process yellow. Mandible yellow. Scape black. Flagellomeres dark. Pronotal lobe yellow. Tegula brown. Wing veins and stigma brown, membrane hyaline. Fore tibia yellow anteriorly dark posteriorly, mid and hind tibia yellow apically and basally. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity medium-length, white. Mesopleuron pilosity medium-length, white. Sternite pubescence colour white. S3 pubescence medium-length, sparse. S4 pubescence medium-length, sparse. S5 pubescence long, dense.

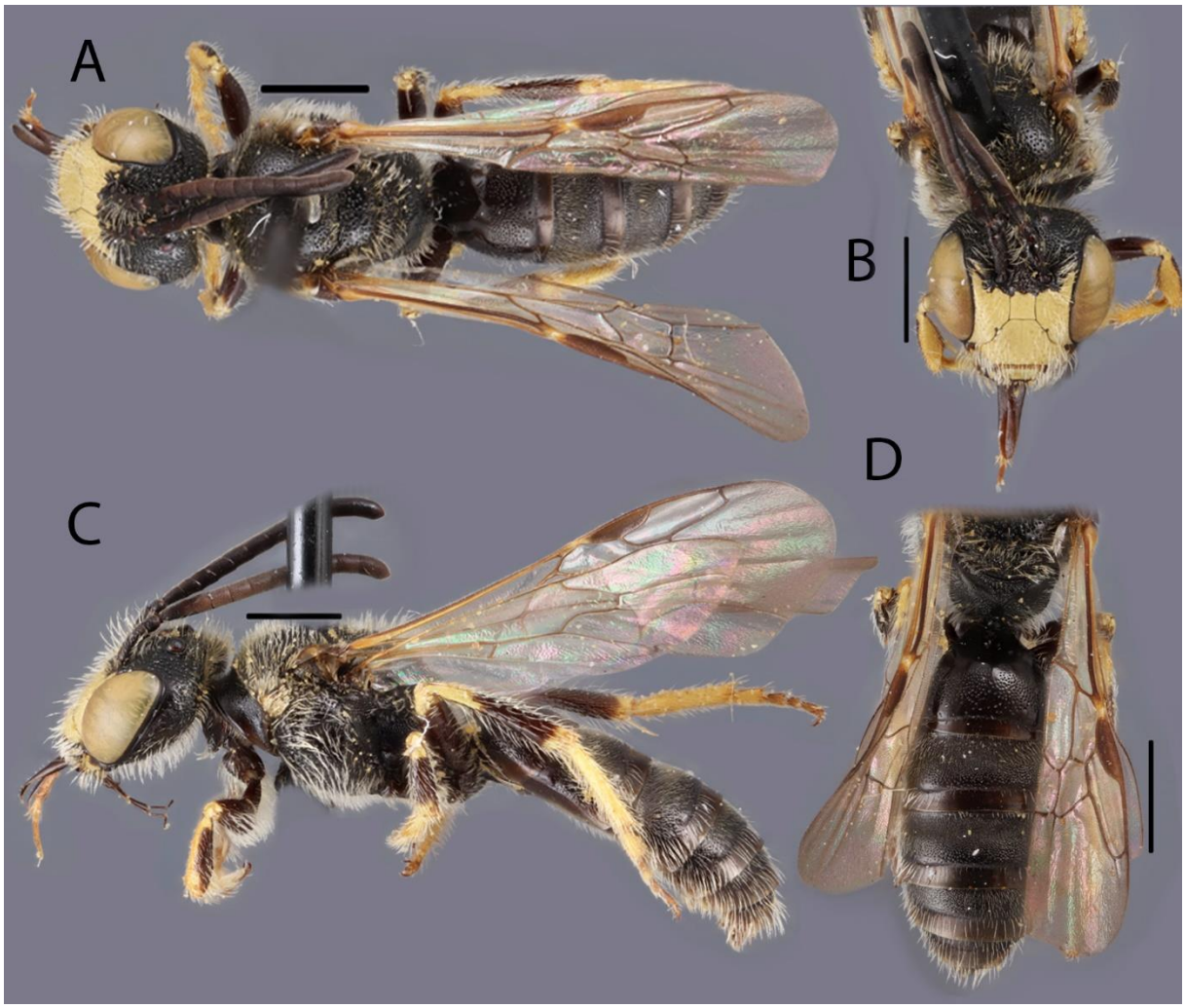


Figure 37. *Protandrena* (*Pterosarus*) *boylei*, ♂. CUIC. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena boylei* is active in August.

Range: USA (Colorado, New Mexico).

***Protandrena* (*Pterosarus*) *californica* (Cresson)**

(Figure 38, Figure 39)

Calliopsis californicus Cresson, 1878: 67. ♂. Lectotype ♂ ANSP: 2197. Lectotype designation by Cresson 1916. Type locality: USA: California. Examined specimen.

Type specimens: Cresson (1878) described *Calliopsis californicus* from twelve male syntypes. Cresson (1916) designated the male lectotype at the ANSP.

Diagnosis:

Males of *Pr*. (*Pt*.) *californica* can be recognized by their facial maculations restricted to clypeus (contrast all other species).

Females of *Pr*. (*Pt*.) *californica* can be recognized by their rectangular labral process (contrast all except: *Pr*. *renimaculata*, and *Pr*. *solidaginis*), and sparse scutum punctures (IS > 4 PD) (contrast remaining).

Material examined:

MEXICO – **Baja California** • 1♂; San Rafael; [31.1153435° N, 115.785983° W]; 01 Apr. 1956; Snelling R.A. leg.; SEMC

USA – **California** • 1♂; Edwards; [34.924° N, 117.8912° W]; 1878; Cresson leg.; ANSP • 1♀; Fresno, Mouth of Mill Creek; 26 Apr. 1981; Bugnosen R. leg.; CAS • 2♀♀, 1♂♂; San Benito, Panoche Hills; [36.6447° N, 120.7318° W]; 10 Apr. 1938; VanDyke L. leg.; SEMC • 48♀♀, 7♂♂; same location as preceding; 10 Apr. 1938; VanDyke E.G. leg.; CAS • 3♂♂; San Diego, Dulzura; [32.6442° N, 116.7814° W]; elev. 853 m.; AMNH • 1♀; San Diego, San Diego;

[32.7153° N, 117.1573° W]; 24 Apr. 1920; Giffard W.M. leg.; CAS • 1♂; San Diego; [32.7153° N, 117.1573° W]; 13 Mar. 1972; Moldenke A.R. leg.; ex *Coreopsis maritima*; INHS • 1♂; 07 Apr. 1940; Timberlake P.H. leg.; ex *Layia elegans*; UCMC

Description

Male:

Structure: Body length range 5.88–7.08 mm. Head broader than long (HL/HW ratio 0.85). Face below antennae convex. Labral process trapezoidal, broader than long, apex emarginate. Clypeus without median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.32). Posterior ocelli 0.31 mm apart. Flagellomeres longer than broad. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.22 mm. Metapostnotum weakly extended medially <25% way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.15 mm. S6 notch deep, extending approximately 1/2 of disk, lateral carina absent.

Sculpture: Clypeus punctation coarse and dense (IS ≤ 0.5 PD). Paraocular punctation coarse and dense (IS = 0.5 PD). Supraclypeal area punctation fine and sparse (IS > 2 PD). Fovea ovate. Foveae slightly converging above, less of a defined impression and more of an impunctate space. Frons punctation reticulate. Vertex punctation fine and dense (IS < 1 PD). Mesoscutum punctation fine and sparse (IS > 4 PD). Scutellum punctation coarse and sparse (IS > 2 PD). Mesopleuron punctation coarse and sparse (IS > 2 PD) denser anteriorly (IS = 1 PD). Lateral propodeum punctation rugose. Posterior propodeum rugose. Posterior propodeum not microsculptured. Dorsal face of T1 punctation very minute and sparse (IS > 10 PD). T2 basal impression deep, basal 2/3 of T2 lineolate. T3 punctation sparse (IS > 1 PD). T4 punctation sparse (IS = 1 PD).

Colour: Clypeus pale yellow. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F3-F9 orange ventrally. Pronotal lobe black. Tegula light brown. Wing veins and stigma brown, membrane light brown. Fore tibia yellow anteriorly and dark posteriorly Mid tibia with small yellow spot at knee Hind tibia entirely dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity long, white. Scutellum pilosity long, white. Mesopleuron pilosity long, white. Sternite pubescence colour yellow. S3 pubescence short, sparse. S4 pubescence medium length, dense, with medially directed apicolateral fringes. S5 pubescence long, medially directed apicolateral fringes.

Female:

Structure: Body length range 6.5–7.25 mm. Head broader than long (HL/HW ratio 0.81). Face below antennae convex. Labral process rectangular, broader than long, apex truncate. Clypeus without median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.06). Posterior ocelli 0.33 mm apart. Flagellomeres broader than long. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.37 mm. Metapostnotum strongly extended medially >50% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.068 mm.

Sculpture: Clypeus punctation fine and sparse (IS = 1). Paraocular punctation fine and sparse (IS = 1). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea clavate. Foveae slightly converging above, less of a defined impression and more of an impunctate space. Frons finely reticulate. Vertex punctation fine and dense (IS < 1 PD). Mesoscutum punctation fine and sparse (IS > 4 PD). Scutellum punctation fine and sparse laterally (IS > 2 PD) denser medially (IS = 1 PD). Mesopleuron punctation fine and sparse (IS > 4 PD). Lateral propodeum finely reticulate.

Posterior propodeum finely reticulate. Posterior propodeum not microsculptured. Dorsal face of T1 punctation very minute and sparse (IS > 10 PD). T2 basal impression shallow, basal 1/3 of T2 lineolate. T3 punctation sparse (IS > 1 PD). T4 punctation sparse (IS > 1 PD).

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F3-F9 orange ventrally. Pronotal lobe black. Tegula light brown. Wing veins and stigma brown, membrane light brown. All tibia dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, yellow. Scutellum pilosity long, yellow. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium length, sparse. S4 pubescence medium length, sparse. S5 pubescence long, medially directed apicolateral fringes.

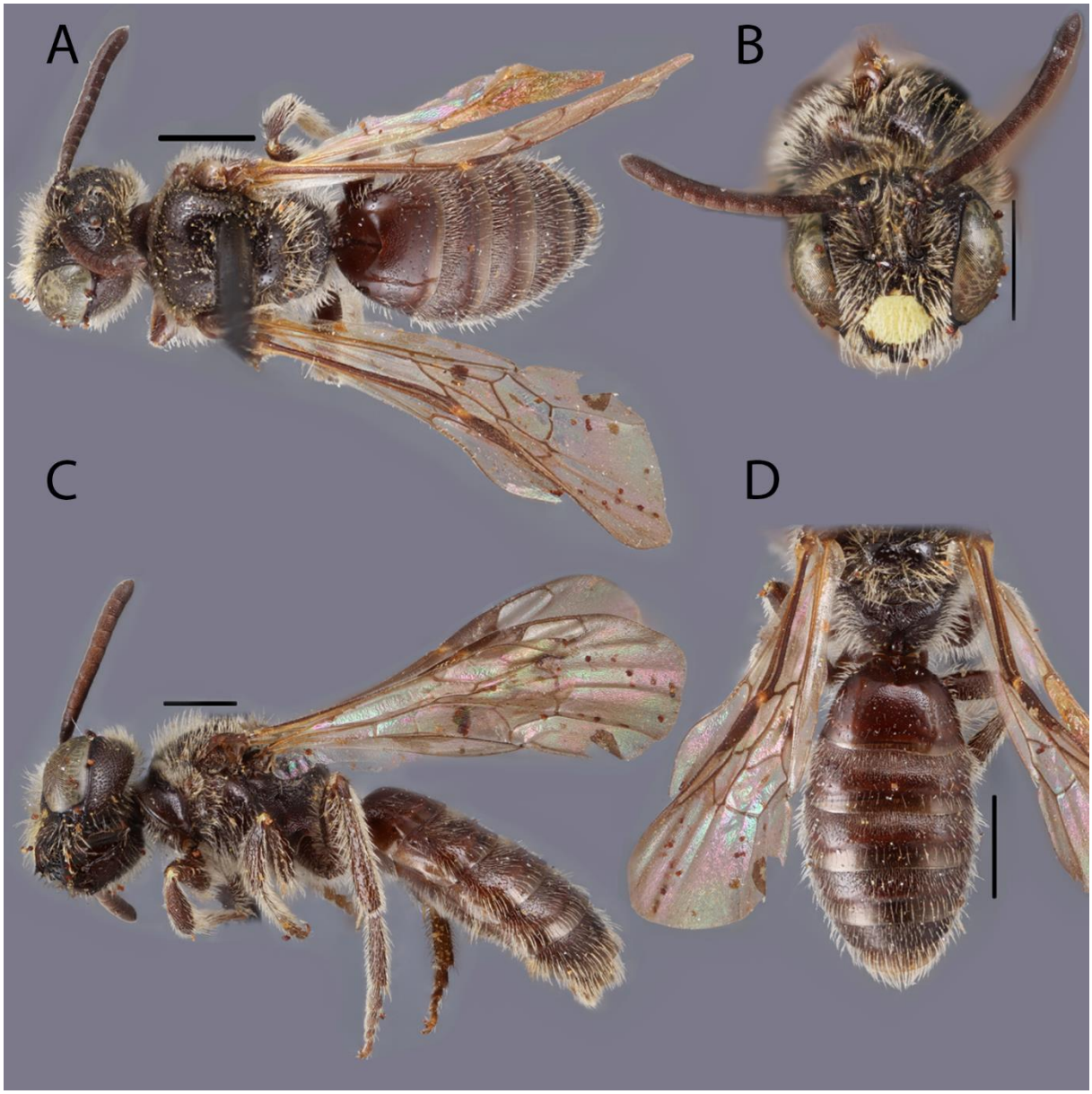


Figure 38. *Protandrena* (*Pterosarus*) *californica*, ♂. CAS. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

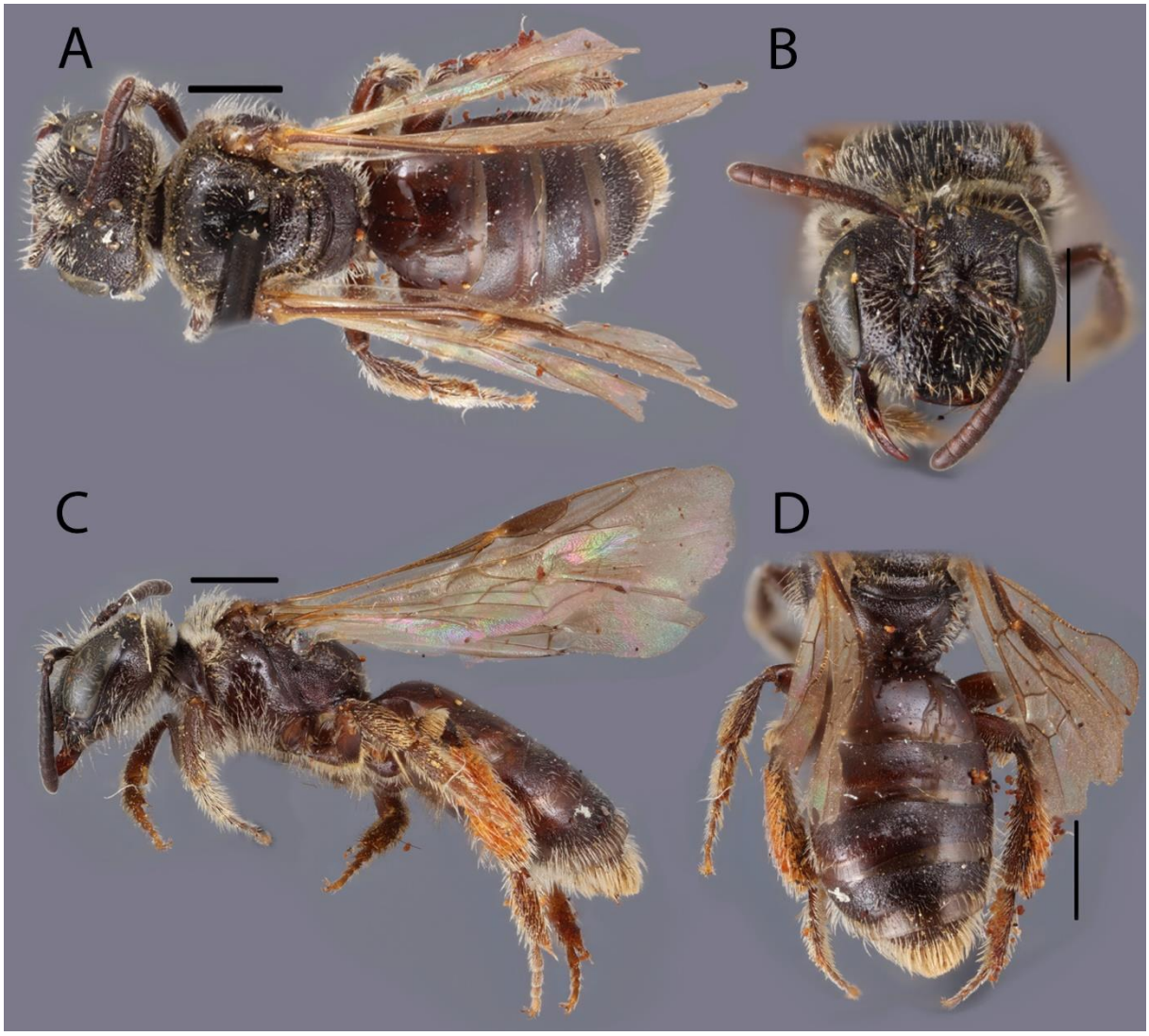


Figure 39. *Protandrena* (*Pterosarus*) *californica*, ♀. CAS. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena californica* is active in March and April. Pierce (1918) recorded *Crawfordia californica* as a parasite of *Protandrena californica*. Floral records for *Protandrena californica* are few, but a preference seems to be shown for the tribe Madieae, specifically on the genus *Layia*.

Range: USA (California), Mexico (Baja California).

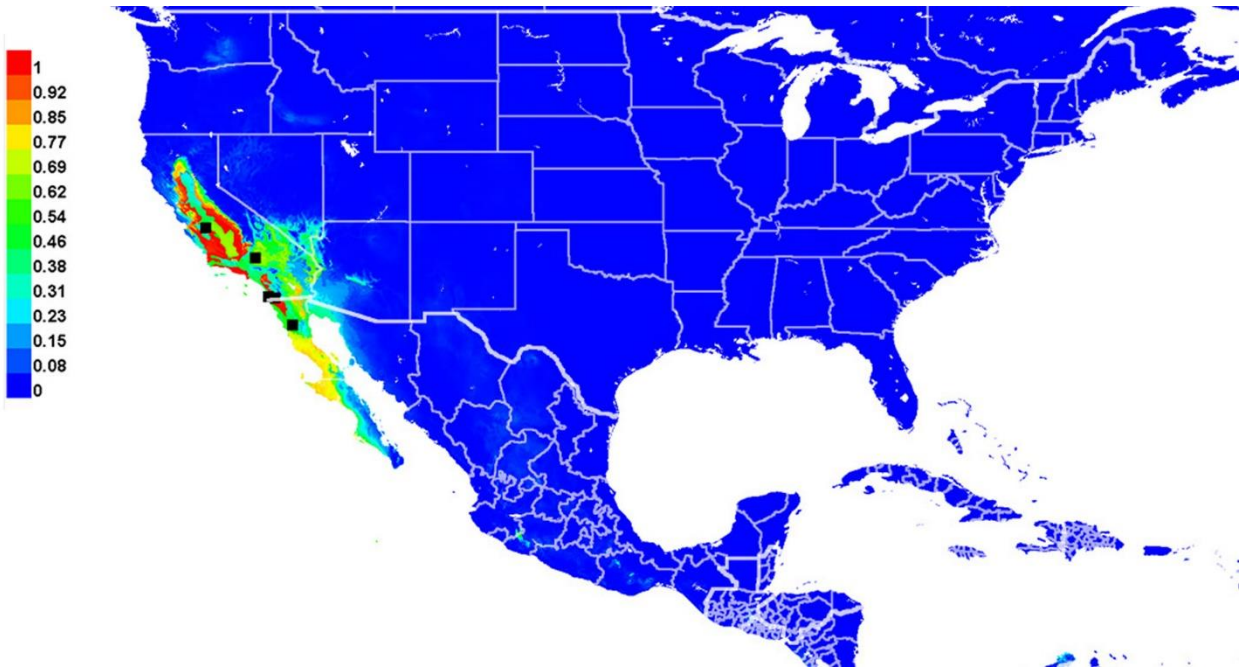


Figure 40. Georeferenced collection records of *Protandrena* (*Pterosarus*) *californica* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *chepesepe* new species**

(Figure 41)

Etymology

The specific epithet *chepesepe* is formed from the Cree words “Chepe” for ghost and “Sepe” for river, in reference to the Spirit River region of Alberta where the type was collected.

Diagnosis:

Males of *Pr*. (*Pt*.) *chepesepe* can be recognized by a combination of their uniformly sparse scutum punctures (IS > 1 PD) (contrast all except: *Pr*. a*mor*, *Pr*. a*lbitarsis*, *Pr*. a*tricornis*, *Pr*.

californica, *Pr*. *illustris*, *Pr*. *leucoptera*, *Pr*. *luxsolaris*, *Pr*. *rowellae*, *Pr*. *skeggox*), full yellow maculations of face (contrast *Pr*. *amor*, *Pr*. a*lbitarsis*, *Pr*. *californica*, *Pr*. *illustris*), rugose posterior face of propodeum (contrast *Pr*. *rowellae*, and *Pr*. *luxsolaris*), dark pronotal lobes (contrast *Pr*. *leucoptera*) and triangular tarsi (contrast *Pr*. *skeggox*).

Material examined:

CANADA – **Alberta** • holotype ♂; Rycroft; [55.7667° N, 118.7167° W]; 07 Aug. 1961; Brooks A.R. leg.; CNC

Description

Male:

Structure: Body length 4.93 mm. Head broader than long (HL/HW ratio 0.94). Face below antennae convex. Labral process trapezoidal, broader than long, apex truncate. Clypeus with median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.22). Posterior ocelli 0.28 mm apart. Flagellomeres longer than broad. Dorsal pronotal carina absent. Prosternum not produced. ITD 0.86 mm. Metapostnotum strongly extended medially >50% way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.1375 mm. S6 notch deep, extending approximately 1/2 of disk, lateral carina absent.

Sculpture: Clypeus punctation fine and sparse (IS > 1 PD). Paraocular punctation fine and sparse (IS > 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 0.5 MOD from dorsal tangent of antennal socket. Frons finely reticulate. Vertex punctation fine and dense (IS < 1 PD). Mesoscutum punctation coarse and sparse (IS > 1 PD). Scutellum punctation coarse and dense (IS < 1 PD). Mesopleuron

punctation fine and sparse (IS = 1 PD). Lateral propodeum finely reticulate. Posterior propodeum rugose. Posterior propodeum not microsculptured. Dorsal face of T1 punctation fine and dense (IS < 1 PD). T2 basal impression deep, approximately 2/3 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus yellow. Supraclypeal area yellow to within 0.5 MOD of antennal socket. Lower paraocular area yellow to within 0.5 MOD of ventral tangent of antennal socket medially, extending along margin of compound eye terminating 1/2 way up antennal socket. Labral process yellow. Mandible yellow. Scape yellow anteriorly. Flagellomeres F2-F11 yellow ventrally. Pronotal lobe black. Tegula brown. Wing veins and stigma brown, membrane light brown. Fore tibia yellow anteriorly dark posteriorly, mid and hind tibiae with reduced dark spot medially. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity medium-length, white. Mesopleuron pilosity medium-length, white. Sternite pubescence colour white. S3 pubescence medium-length, sparse. S4 pubescence medium-length, sparse. S5 pubescence long, medially directed apicolateral fringes.

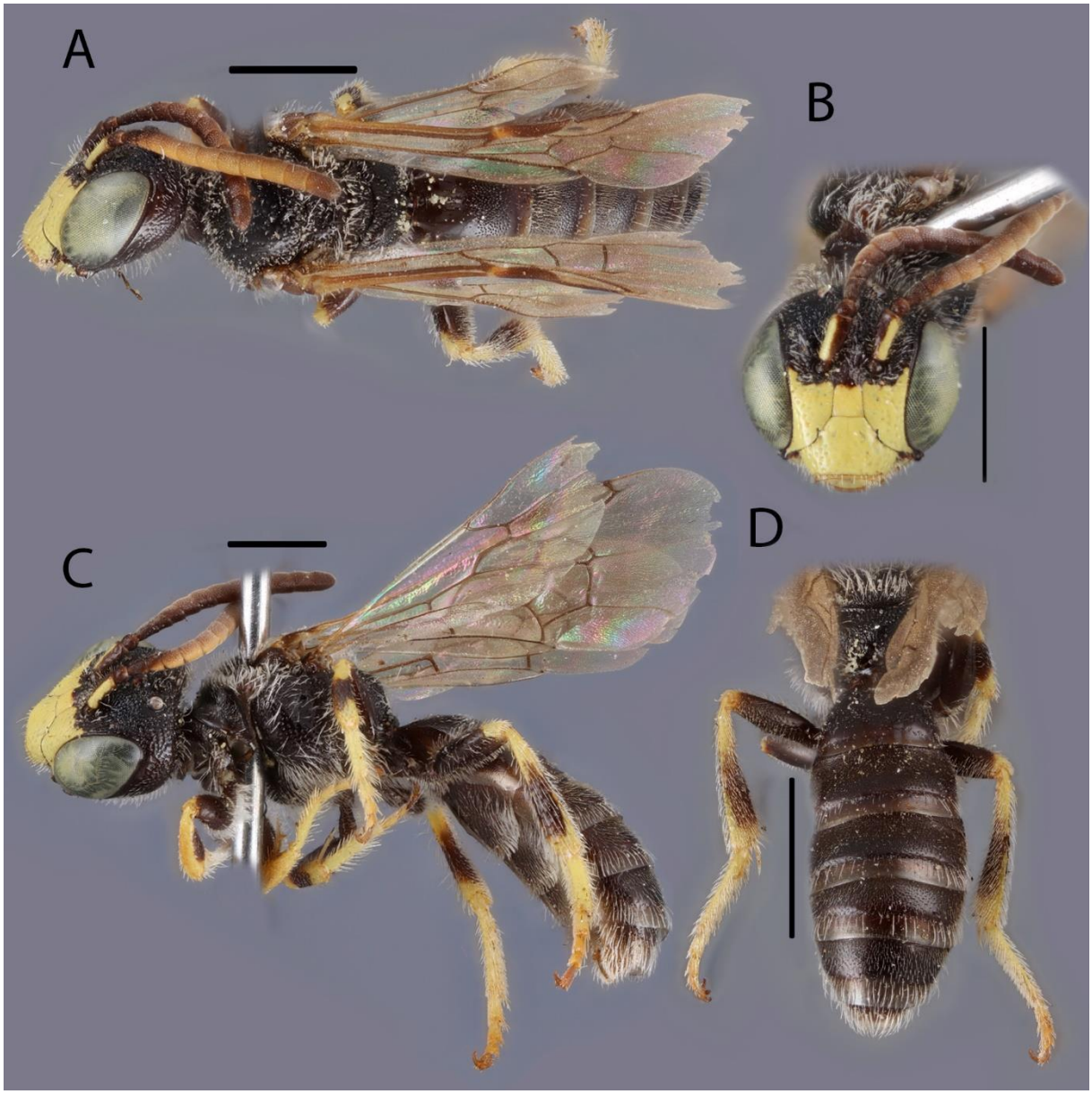


Figure 41. *Protandrena* (*Pterosarus*) *chepesepe*, ♂. CNC. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

***Protandrena* (*Pterosarus*) *citrinifrons* (Viereck)**

(Figure 42, Figure 43)

Panurginus citrinifrons Viereck, 1903: 52. ♂. Holotype ♂ ANSP: 10187. Type locality: USA; New Mexico: Beulah. 17 Aug 1901. Examined by photos.

Panurginus nubis Cockerell, 1913: 193. ♀. Holotype ♀ CAS 15417. Type locality: USA; New Mexico: Cloudcroft. 5 Sep 1913. **New synonymy**. Examined by photos.

Panurginus planatus Cockerell, 1918: 171. ♂. Holotype ♂ NMNH: 533832. Type locality: Mexico; Meadow Valley. 1918. **New synonymy**. Examined by photos.

Type specimens: Viereck's (1903) description of *Panurginus citrinifrons* was based solely on the male holotype. Cockerell (1913) described the female of *Panurginus nubis*. The number of specimens was not indicated. Cockerell (1918) described *Panurginus planatus* solely from the male holotype. Examination of the type specimens of *Panurginus citrinifrons* and *Panurginus planatus* show them to be the same morphologically. *Panurginus nubis* is considered the female of *Panurginus citrinifrons* due to the proximity of the type locations, and the uniquely shared feature of a strongly impressed median line on the clypeus and sparse clypeus punctures (IS > 1 PD).

Diagnosis:

Males of *Pr*. (*Pt*.) *citrinifrons* can be recognized by a combination of their inflated tarsi (contrast all except: *Pr*. *albertensis Pr*. *atricornis Pr*. *boylei Pr*. *occultata Pr*. *piercei Pr*. *rowellae Pr*. *skeggox*), face not entirely yellow below antennae (contrast *Pr*. *albertensis Pr*. *boylei Pr*. *occultata Pr*. *piercei Pr*. *rowellae Pr*. *skeggox*), and clypeus with strongly impressed median line (contrast *Pr. atricornis*).

Females of *Pr*. (*Pt*.) *citrinifrons* can be recognized by their scutum punctures of two types (contrast all except: *Pr. atricornis*, *Pr. citrinifrons*, *Pr. didirupa*, *Pr. occultata*, *Pr. prata*, *Pr. leucoptera*), clypeus with strong medially impressed line (contrast *Pr. atricornis*, *Pr. occultata*, *Pr. leucoptera*) and semicircular labral process (contrast remaining).

Material examined:

USA – **Arizona** • 2♂♂; Cochise, Chiricahua Mountains, Above Rustler Park; 31.8814° N, 109.2853° W; elev. 2600 – 2800 m.; 26 Aug. 2000; Brooks R. leg.; ex *Pseudognaphalium pringlei*; SEMC • 2♂♂; same location as preceding; 26 Aug. 2000; Brooks R. leg.; ex *Geranium richardsonii*; SEMC • 5♂♂; same location as preceding; 26 Aug. 2000; Brooks R. leg.; ex *Erigeron neomexicanus*; SEMC • 1♀; same location as preceding; 26 Aug. 2000; Brooks R. leg.; ex *Gutierrezia wrightii*; SEMC • 1♂; Cochise, Chiricahua Mountains, Barfoot Park; [31.9151° N, 109.2845° W]; 06 Sep. 2018; ex *Cosmos parviflorus*; OSAC: LP • 9♀♀, 7♂♂; Cochise, Chiricahua Mountains, near Rustler Park; [31.9034° N, 109.2756° W]; 20 Aug. 2000; Danforth B.N. leg.; ex *Erigeron* sp.; CUIC • 1♂; Cochise, Chiricahua Mountains, Rustler Park; [31.9034° N, 109.2756° W]; elev. 2499 m.; 02 Aug. 1972; Eickwort G.C. leg.; CUIC • 1♂; Cochise, Huachuca Mountains, Miller Canyon; [31.2453° N, 110.1633° W]; elev. 2000-3000 m.; 17 Aug. 2000; Danforth B.N. leg.; CUIC • 1♂; Cochise, Huachuca Mountains, Miller Canyon; [31.2453° N, 110.1633° W]; elev. 2000 – 3000 m.; 17 Aug. 2000; Danforth B.N. leg.; ex *Salvia* sp.; CUIC • 1♀, 6♂♂; Cochise, Huachuca Mountains, Miller Canyon; 31.4011° N, 110.3103° W; elev. 2520 m.; 17 Aug. 2000; Brooks R. leg.; ex *Erigeron neomexicanus*; SEMC • 4♂♂; same location as preceding; 17 Aug. 2000; Brooks R. leg.; ex *Gutierrezia wrightii*; SEMC • 2♂♂; Cochise, Onion Saddle; 31.9333° N, 109.263° W; 26 Aug. 2019; Gibbs J. leg.; WRME • 1♀, 1♂♂; Cochise,

Onion Saddle; 31.933° N, 109.264° W; 30 Aug. 2016; Neff J.L. leg.; ex *Solidago wrightii*; CTMI • 2♂♂; Cochise, Onion Saddle; [31.9333° N, 109.2636° W]; 30 Aug. 2015; Spring M. leg.; OSUC: KG • 1♂; Cochise, Portal (4 mi W); [31.9265° N, 109.2231° W]; 26 Sep. 1982; Pulawski W.J. leg.; CAS • 7♂♂; Cochise, Rustler Park; 31.906° N, 109.278° W; 24 Aug. 2019; Gibbs J. leg.; WRME • 5♂♂; same location as preceding; 26 Aug. 2019; Gibbs J. leg.; WRME • 1♂; Cochise, Rustler Park; 31.9017° N, 109.2778° W; 20 Aug. 2000; Smith A. leg.; BBSL • 27♂♂; Cochise, Rustler Park (1 mi. NE); 31.9133° N, 109.2792° W; 20 Aug. 2000; Griswold T.L. leg.; BBSL • 1♀; Cochise, Rustler State Park; 31.9136° N, 109.2672° W; elev. 2420 m.; 26 Aug. 2000; Brooks R. leg.; SEMC • 1♂; Cochise, Rustler State Park; 31.9133° N, 109.2722° W; elev. 2420 m.; 26 Aug. 2000; Brooks R. leg.; SEMC • 1♂; same location as preceding; 26 Aug. 2000; Brooks R. leg.; ex *Heliopsis parvifolia*; SEMC • 1♂; Cochise, Sierra Vista (12.5 km S), Ramsey Canyon; 31.4477° N, 110.3095° W; 13 Aug. 1986; Brown B. leg.; PMAE • 1♀; Coconino, Grand Canyon; [36.1069° N, 112.1129° W]; 19 Aug. 1939; VanDyke E.G. leg.; CAS • 6♂♂; Coconino, Grand Canyon National Park, South Rim; [35.9847° N, 111.9767° W]; 21 Aug. 1973; Eickwort G.C. leg.; CUIC • 2♂♂; Graham, Mount Graham; [32.7017° N, 109.8715° W]; elev. 2591 m.; 29 Aug. 1995; Ascher J.S. leg.; CUIC • 1♂; Greenlee, Route 666 (1 mi. S Apache County line); [33.7653° N, 109.1793° W]; 15 Sep. 1970; Bartholomew P.S. leg.; CAS – **Colorado** • 1♂; Boulder, Ward (2 mi. SW); 40.0517° N, 105.5351° W; elev. 2743 m.; 08 Aug. 1962; Lanham U.N., Vogel B. leg.; UCMC– **New Mexico** • 1♂; Catron, Gila National Forest, Leggett Peak (5.1 km NW); 33.7378° N, 108.9406° W; 28 Aug. 2009; Griswold T.L. leg.; BBSL • 1♂; Grant, Gila National Forest, McMillan Campground along Cherry Creek (1.5 km NE); 32.934° N, 108.2032° W; 30 Aug. 2009; Griswold T.L. leg.; BBSL • 1♀, 1♂♂; Grant, Gila National Forest, Scott Peak, Gila National forest (0.8 km N); 32.9526° N, 108.2095° W; 30 Aug.

2009; Griswold T.L. leg.; BBSL • 8♂♂; Hidalgo, Rodeo; [31.8354° N, 109.0312° W]; 22 Sep. 1999; Danforth B.N., Magnacca leg.; CUIC • 1♂; Mora, Morphy Lake State Park; [35.938° N, 105.3941° W]; 29 Jul. 1972; Eickwort G.C. leg.; CUIC • 4♂♂; Otero, Cloudcroft; [32.9573° N, 105.7425° W]; elev. 2591 m.; 31 Jul. 1972; Eickwort G.C. leg.; CUIC • 1♀; same location as preceding; 4997; Cockerell T.D.A. leg.; CAS • 1♂; Otero, Water Canyon, Rio Penasco; 32.8288° N, 105.7651° W; 29 Jul. 2009; Griswold T.L. leg.; BBSL • 1♂; San Miguel, Beulah; [35.364° N, 105.45° W]; 17 Aug. 1901; Skinner H. leg.; ANSP • 3♀♀; Sierra, Hillsboro; 32.895° N, 107.555° W; elev. 1650 m.; 28 Sep. 1999; Brooks R., Michener C.D. leg.; ex *Heliomeris multiflora* nevadensis; SEMC

Description

Male:

Structure: Body length range 4.93–5.75 mm. Head broader than long (HL/HW ratio 0.9). Face below antennae convex. Labral process trapezoidal, broader than long, apex emarginate. Clypeus with median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.27). Posterior ocelli 0.27 mm apart. Flagellomeres much longer than broad. Dorsal pronotal carina absent. Prosternum not produced. ITD 0.91 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 inflated. Fore tarsi width 0.18 mm. S6 notch deep, extending approximately 1/2 of disk, lateral carina absent.

Sculpture: Clypeus punctation coarse and sparse (IS > 1 PD). Paraocular punctation coarse and sparse (IS = 1 PD). Supraclypeal area punctation fine and sparse (IS = 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 0.5 MOD from dorsal tangent of antennal socket. Frons finely reticulate. Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum

punctation coarse and sparse (IS = 1 – 2 PD). Scutellum punctation coarse and dense (IS < 1 PD). Mesopleuron punctation fine and sparse (IS > 1 PD). Lateral propodeum finely reticulate. Posterior propodeum finely reticulate. Posterior propodeum not microsculptured. Dorsal face of T1 punctation fine and dense laterally (IS < 1 PD) impunctate medially. T2 basal impression deep, approximately 2/3 of T2 lineolate basally. T3 punctation sparse (IS > 1 PD). T4 punctation absent.

Colour: Clypeus yellow. Supraclypeal area with yellow quadrate spot. Lower paraocular area yellow reaching clypeus medially, extending along compound eye terminating in line with supraclypeal mark, approximately 1 MOD from antennal socket. Labral process yellow. Mandible yellow. Scape black. Flagellomeres dark. Pronotal lobe black. Tegula brown. Wing veins and stigma brown, membrane light brown. Fore tibia yellow anteriorly dark posteriorly, mid and hind tibia yellow apically and basally. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity long, yellow/brown. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium-length, sparse. S4 pubescence medium-length, sparse. S5 pubescence long, medially directed apicolateral fringes.

Female:

Female: Structure: Body length range 5.6–6.1 mm. Head broader than long (HL/HW ratio 0.87). Face below antennae convex. Labral process semicircular, broader than long, apex rounded. Clypeus with median impressed line. Compound eyes parallel (UOD/LOD ratio 1). Posterior ocelli 0.28 mm apart. Flagellomeres about equal in length and width. Dorsal pronotal carina

absent. Prosternum not produced. ITD 1.19 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.0625 mm.

Sculpture: Clypeus punctation coarse and sparse (IS > 1 PD). Paraocular punctation coarse and sparse (IS > 1 PD). Supraclypeal area punctation fine and sparse (IS = 1 PD). Fovea clavate. Foveae converging above, posterior end terminating 2/3 down antennal socket. Frons punctation fine and dense (IS < 1 PD). Vertex punctation coarse and sparse (IS = 1 PD). Mesoscutum punctation fine and sparse (IS > 1 PD). Scutellum punctation fine and sparse laterally (IS > 2 PD) denser medially (IS = 1 PD). Mesopleuron punctation coarse and sparse (IS = 1 PD). Lateral propodeum finely reticulate. Posterior propodeum finely reticulate. Posterior propodeum tessellate. Dorsal face of T1 punctation very fine and sparse (IS > 3 PD). T2 basal impression shallow, basal 1/2 of T2 lineolate. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F3-F8 yellow ventrally. Pronotal lobe black. Tegula brown. Wing veins and stigma brown, membrane hyaline. Fore tibia with yellow spot at knee, remaining tibia entirely black. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, yellow. Scutellum pilosity long, yellow. Mesopleuron pilosity long, yellow. Sternite pubescence colour white. S3 pubescence medium length, sparse. S4 pubescence medium length, sparse. S5 pubescence long, medially directed apicolateral fringes.

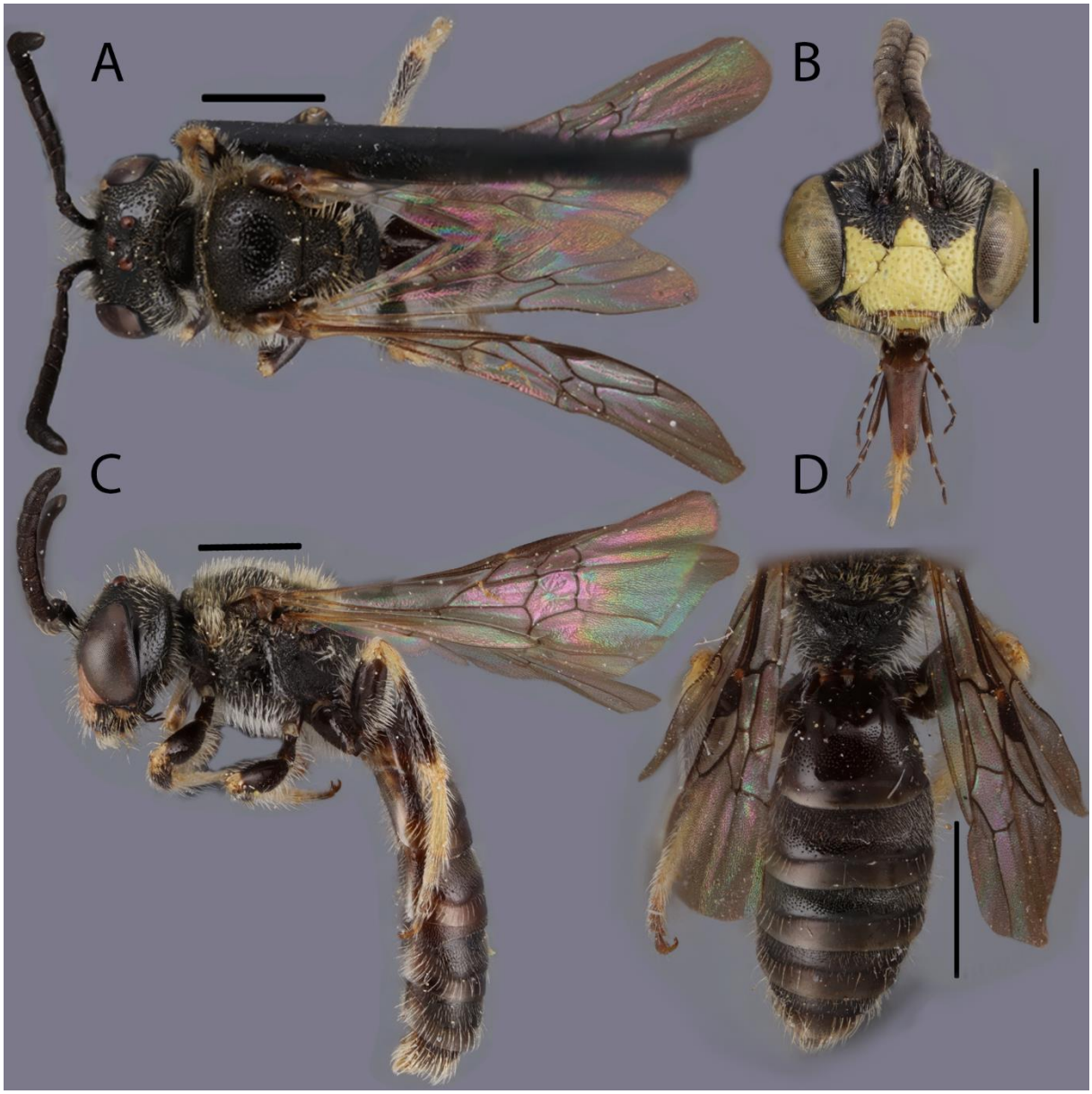


Figure 42. *Protandrena (Pterosarus) citrinifrons*, ♂. CUIC. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

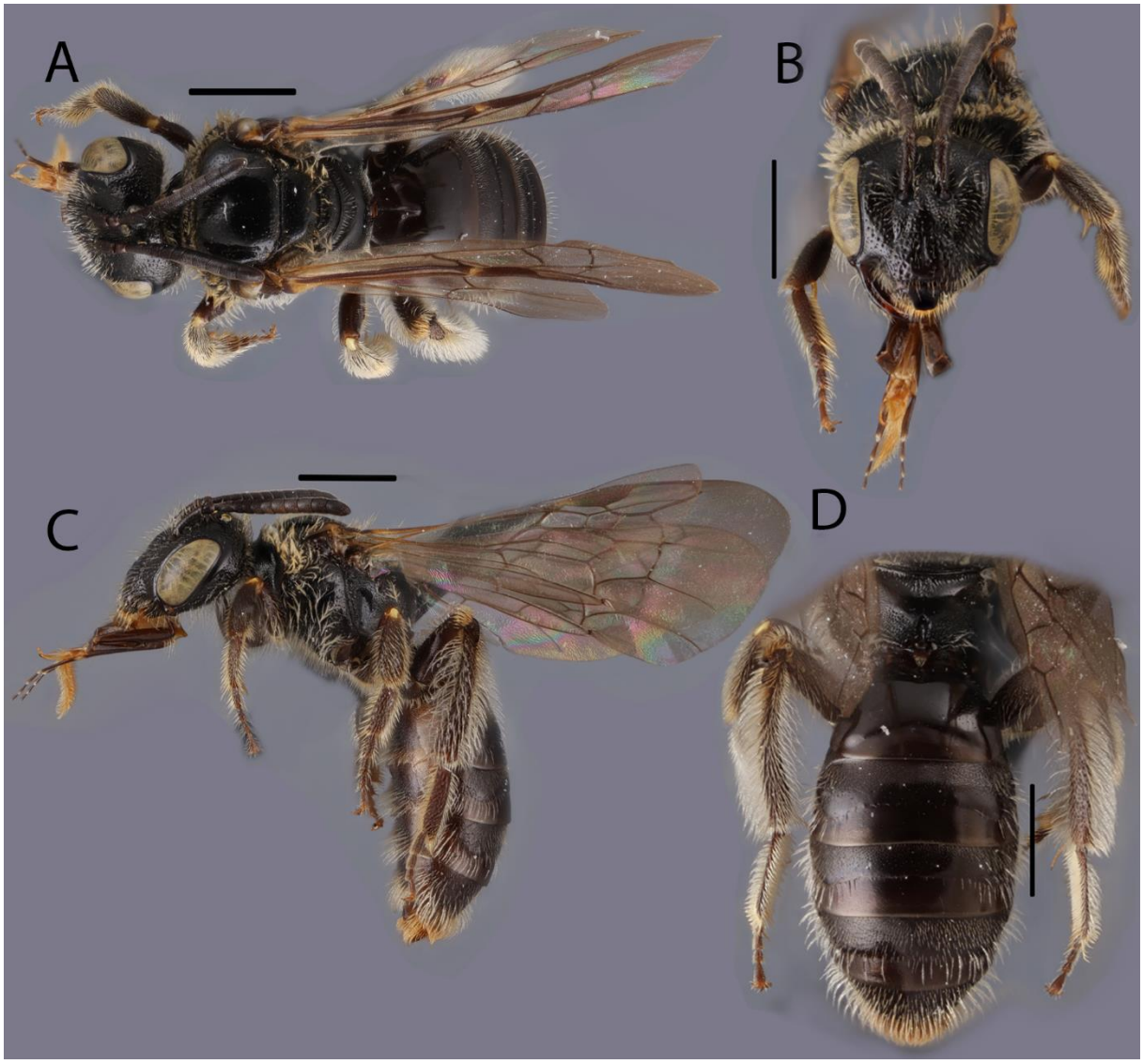


Figure 43. *Protandrena* (*Pterosarus*) *citrinifrons*, ♀. SEMC_196917 **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena citrinifrons* is active from July to September. Most floral records come from the tribe Astereae, with specific preference for the genus *Erigeron*.

Range: USA (Arizona, New Mexico).

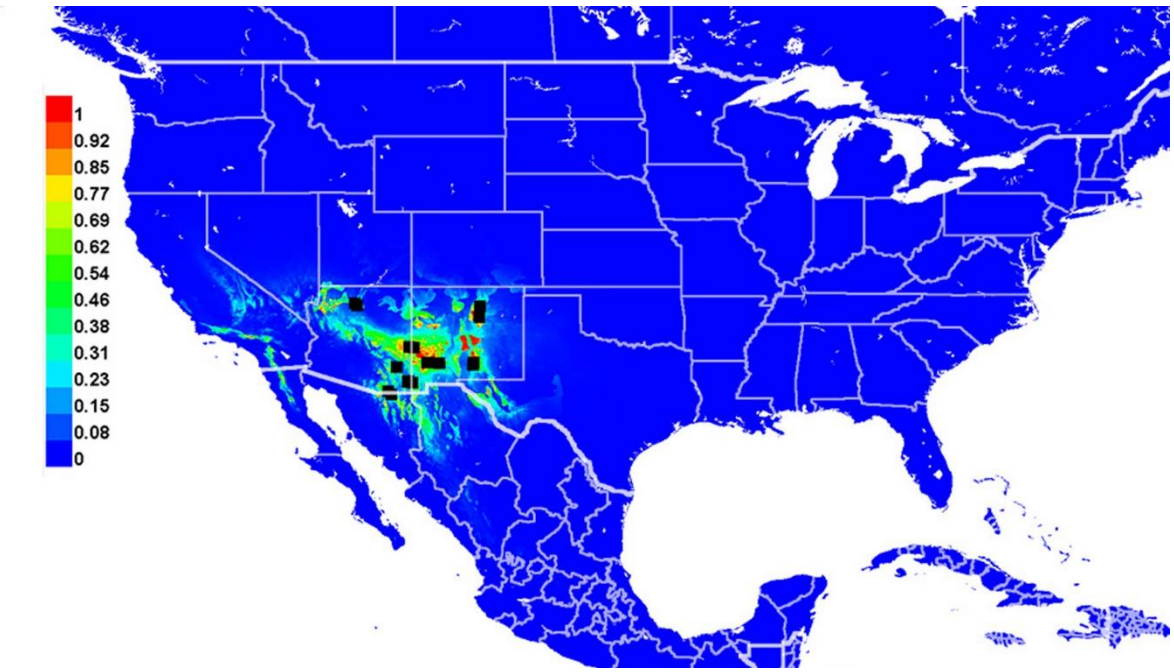


Figure 44. Georeferenced collection records of *Protandrena* (*Pterosarus*) *citrinifrons* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *citripes* (Ashmead)**

(Figure 45, Figure 46)

Calliopsis citripes Ashmead, 1890: 5. ♂. Holotype ♂ NMNH: 533804. Type locality: USA; Colorado: Smith's Park. Examined by photos.

Type specimens: Ashmead's (1890) description of *Calliopsis citripes* was based solely on the male holotype.

Diagnosis:

Males of *Pr*. (*Pt*.) *citripes* can be recognized by their finely reticulate scutum (contrast all other species).

Females of *Pr*. (*Pt*.) *citripes* can be recognized by a combination of their dark flagella (contrast all except: *Pr*. *barberi*, *Pr*. *didirupa*, *Pr*. *nudescens*, *Pr*. *porterae*, *Pr*. *ehnesae*, *Pr*. *ximenesiae*) and dense (IS < 1 PD) remarkably deep scutum punctures (contrast remaining)

Material examined:

MEXICO – **Guanajuato** • 3♂♂; Leon (10 mi. NW); [21.22° N, 101.77° W]; 19 Aug. 1954; Chilcott J.G. leg.; CNC – **Jalisco** • 1♂; La Barca (2 mi. W); [20.29° N, 102.59° W]; 04 Jul. 1984; Wagner P.M. Wagner P.K. leg.; TAMUIC – **Quere Taro** • 1♂; San Juan Del Rio (10 mi. E); [20.39° N, 99.85° W]; 30 Jul. 1954; Chilcott J.G. leg.; CNC – **Sonora** • 1♂; Agua Prieta (30 km E), Rancho San Bernardino Los Ojitos, main houses (3 km S); [31.3002° N, 109.2625° W]; 26 Sep. 2001; Minckley R.L. leg.; ex *Helenium*; MCUR

USA – **Arizona** • 1♀; Apache, Alpine; [33.8481° N, 109.1431° W]; 01 Aug. 1973; Eickwort G.E. leg.; CUIC • 1♀; Apache, Luna Lake (3.6 km SSE); 33.8107° N, 109.0473° W; 28 Aug. 2009; Griswold T.L. leg.; BBSL • 1♀, 1♂; Apache, Springerville (1.2 km NNW); 34.1428° N, 109.2925° W; 28 Aug. 2009; Griswold T.L. leg.; BBSL • 1♀; Cochise, Palominas; [31.3798° N, 110.1184° W]; 03 Sep. 2003; Ascher J.S., Rozen J.G. leg.; AMNH • 1♂; Cochise, Portal, Southwest Research Station; [31.884° N, 109.2061° W]; elev. 1646 m.; 30 Aug. 1968; Rozen J.G., Favreau leg.; AMNH • 1♂; Cochise, Rustler Park (1 mi. NE); 31.9133° N, 109.2792° W; 20 Aug. 2000; Griswold T.L. leg.; BBSL • 4♀♀; Coconino, Mormon Lake (5 mi. N); 35.038° N, 111.4546° W; 03 Sep. 2008; Griswold T.L. leg.; BBSL • 1♂; Douglas, Apache (15 mi. SW); [31.5727° N, 109.2594° W]; 24 Aug. 1996; Rozen J.G., Rozen B.L. leg.; ex *Heterotheca subaxillaris*; AMNH • 1♂; Greenlee, Apache-Sitgreaves National Forest, Hannagan Meadow; [33.6385° N, 109.3271° W]; 01 Sep. 2018; ex *Erigeron tracyi*; OSAC: LP • 2♂♂; Navajo, Show

Low; [34.2542° N, 110.0298° W]; 22 Aug. 1973; Eickwort G.E., Eickwort K. leg.; CUIC • 1♂; Santa Cruz, Lyle Canyon Road; [31.5119° N, 110.4875° W]; elev. 1550 m.; 29 Aug. 2000; Brooks R. leg.; ex *Erigeron divergens*; SEMC – **Colorado** • 1♂; Custer, Smith's Park; [38.2036° N, 105.6442° W]; Cockerell T.D.A. leg.; USNM – **New Mexico** • 1♀; Grant, Silver City (4 mi N); 32.8328° N, 108.275° W; elev. 1900 m.; 17 Sep. 1999; Brooks R., Michener C.D. leg.; ex *Cosmos parviflorus*; SEMC • 1♂; Grant, Silver City ,Wind Canyon (6.3 km NW); 32.787° N, 108.3407° W; 30 Aug. 2009; Griswold T.L. leg.; BBSL • 1♂; Grant, Silver City, Maudes Canyon (7.8 km NNE); 32.83° N, 108.2369° W; Griswold T.L. leg.; BBSL • 4♂♂; Hidalgo, Animas; 31.72° N, 108.822° W; 23 Aug. 2007; Gibbs J. leg.; WRME • 1♂; same location as preceding; 07 Sep. 2012; Gibbs J. leg.; WRME • 1♀; Hidalgo, Animas (12 mi. S); 31.7784° N, 108.8055° W; 25 Aug. 2005; Griswold T.L. leg.; BBSL • 2♀♀; Hidalgo, Animas (16 mi. S); [31.7279° N, 108.8222° W]; 23 Aug. 2007; Ascher J.S., Dong C. leg.; AMNH • 11♂♂; Hidalgo, Animas (16 mi. S); 31.7235° N, 108.8223° W; 25 Aug. 2005; Griswold T.L. leg.; ex *Heterotheca* sp.; BBSL • 1♂; Hidalgo, Animas (20 mi. S); 31.587° N, 108.868° W; 30 Aug. 2015; Neff J.L. leg.; ex *Grindelia squarrosa*; CTMI • 1♂; Hidalgo, Animas (20 mi. S); [31.6686° N, 108.8413° W]; 08 Sep. 2003; Ascher J.S., Wilson D.S. leg.; AMNH • 1♀; Hidalgo, Animas (26 mi. S); 31.585° N, 108.7° W; 18 Sep. 2012; Neff J.L. leg.; ex *Heterotheca subaxillaris*; CTMI • 1♂; Hidalgo, Animas (26 mi. S); 31.5844° N, 108.8703° W; elev. 1219 m.; 19 Aug. 2001; Giles V. leg.; ex *Heterotheca subaxillaris*; AMNH • 1♀; same location as preceding; 19 Aug. 2001; Giles V. leg.; AMNH • 1♀; Hidalgo, Animas (26 mi. S); [31.5849° N, 108.8702° W]; 10 Sep. 1976; Rozen J.G. leg.; AMNH • 3♂♂; Hidalgo, Animas (27 - 32 mi. S); [31.5018° N, 108.8779° W]; 24 Aug. 1994; Ascher J.S., Rozen J.G. leg.; AMNH • 2♂♂; Hidalgo, Animas (28 mi. S); [31.5539° N, 108.8763° W]; 27 Aug. 2009; Rozen J.G. leg.; AMNH • 1♀; Hidalgo, Animas (29

mi. S); [31.5435° N, 108.8775° W]; 28 Aug. 1977; Rozen J.G. leg.; AMNH • 2♂♂; Hidalgo, Animas (31 mi. S); [31.5018° N, 108.8779° W]; 18 Aug. 1974; Rozen J.G. leg.; AMNH • 1♀; same location as preceding; 10 Sep. 1976; Rozen J.G. leg.; AMNH • 2♀♀, 4♂♂; Hidalgo, Animas (33–37 mi. S); [31.5018° N, 108.8779° W]; 22 Aug. 1997; Rozen J.G., McAdams B. leg.; AMNH • 1♀, 1♂; Hidalgo, Animas (34 mi. S); [31.5018° N, 108.8779° W]; 29 Aug. 1982; Rozen J.G., Rozen B.L. leg.; AMNH • 1♂; Hidalgo, Cloverdale; [31.417° N, 108.9298° W]; 25 Aug. 1995; Rozen J.G., Budlick S.A. leg.; AMNH

Description

Male:

Structure: Body length range 5–5.92 mm. Head broader than long (HL/HW ratio 0.85). Face below antennae convex. Labral process trapezoidal, broader than long, apex emarginate. Clypeus without median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.27). Posterior ocelli 0.28 mm apart. Flagellomeres longer than broad. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.04 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.11 mm. S6 notch shallow only 1/3, lateral carina absent.

Sculpture: Clypeus punctation fine and dense (IS < 1 PD). Paraocular punctation fine and dense (IS < 1 PD). Supraclypeal area punctation fine and dense (IS < 1 PD). Fovea clavate. Foveae converging above, narrow end terminating in line with dorsal tangent of antennal socket. Frons finely reticulate. Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation finely reticulate. Scutellum punctation finely reticulate. Mesopleuron punctation coarse and dense (IS < 1 PD). Lateral propodeum finely reticulate. Posterior propodeum rugose. Posterior propodeum

not microsculptured. Dorsal face of T1 punctation fine and dense (IS < 1 PD). T2 basal impression deep, basal 2/3 of T2 lineolate. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus yellow. Supraclypeal area yellow to within 1 MOD of antennal socket. Lower paraocular area yellow to within 1.5 MOD of antennal socket medially, extends along compound eye terminating in line with ventral tangent of antennal socket. Labral process yellow. Mandible yellow. Scape black. Flagellomeres dark. Pronotal lobe black. Tegula light brown. Wing veins and stigma brown, membrane light brown. Fore tibia yellow anteriorly dark posteriorly, mid and hind tibia with reduced dark spot medially, yellow apically and basally. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity of two forms long and medium-length, white. Mesopleuron pilosity long, white. Sternite pubescence colour yellow. S3 pubescence medium length, sparse. S4 pubescence medium length, sparse. S5 pubescence long, medially directed apicolateral fringes.

Female:

Structure: Body length range 6.23–7.42 mm. Head broader than long (HL/HW ratio 0.82). Face below antennae convex. Labral process trapezoidal, broader than long, apex truncate. Clypeus without median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.05). Posterior ocelli 0.31 mm apart. Flagellomeres about equal in length and width. Dorsal pronotal carina present laterally but not medially. Prosternum not produced. ITD 1.42 mm. Metapostnotum weakly extended medially <25% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.066 mm.

Sculpture: Clypeus punctation coarse and dense (IS < 1 PD). Paraocular punctation coarse and dense (IS < 1 PD). Supraclypeal area punctation fine and dense (IS < 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 2/3 down antennal socket. Frons finely reticulate. Vertex punctation fine and dense (IS < 1 PD). Mesoscutum punctation fine and dense (IS < 1 PD). Scutellum punctation fine and dense laterally (IS < 1 PD) finely reticulate medially. Mesopleuron punctation coarse and dense (IS < 1 PD). Lateral propodeum finely reticulate. Posterior propodeum finely reticulate. Posterior propodeum not microsculptured. Dorsal face of T1 punctation fine and sparse (IS > 6 PD). T2 basal impression shallow, basal 1/3 of T2 lineolate. T3 punctation sparse (IS = 1 PD). T4 punctation absent.

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres dark. Pronotal lobe black. Tegula light brown. Wing veins and stigma brown, membrane light brown. Fore and mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity medium-length, yellow/brown. Scutellum pilosity long, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium length, sparse. S4 pubescence medium length, sparse. S5 pubescence long, medially directed apicolateral fringes.

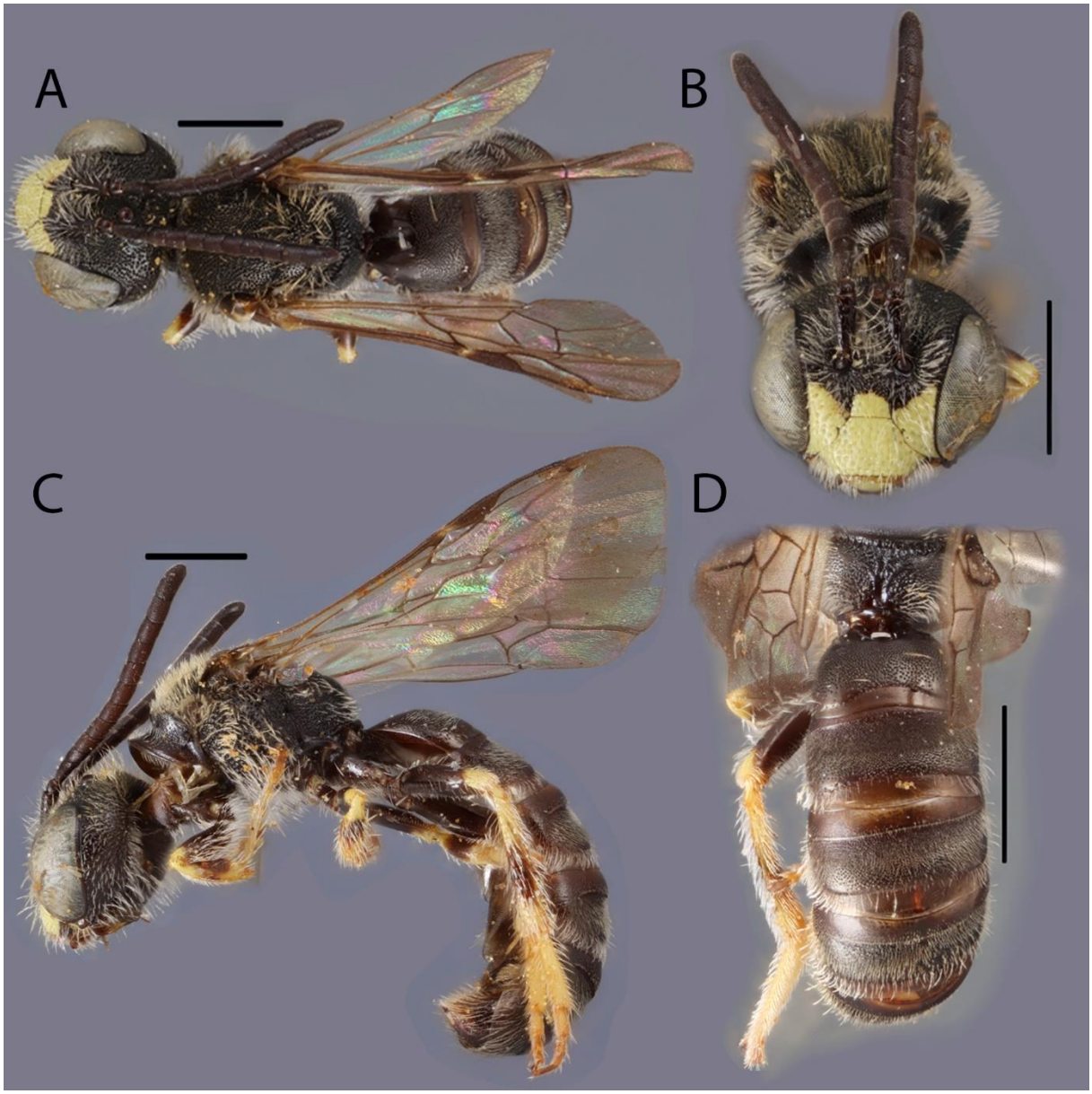


Figure 45. *Protandrena* (*Pterosarus*) *citripes*, ♂. AMNH_00220535. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

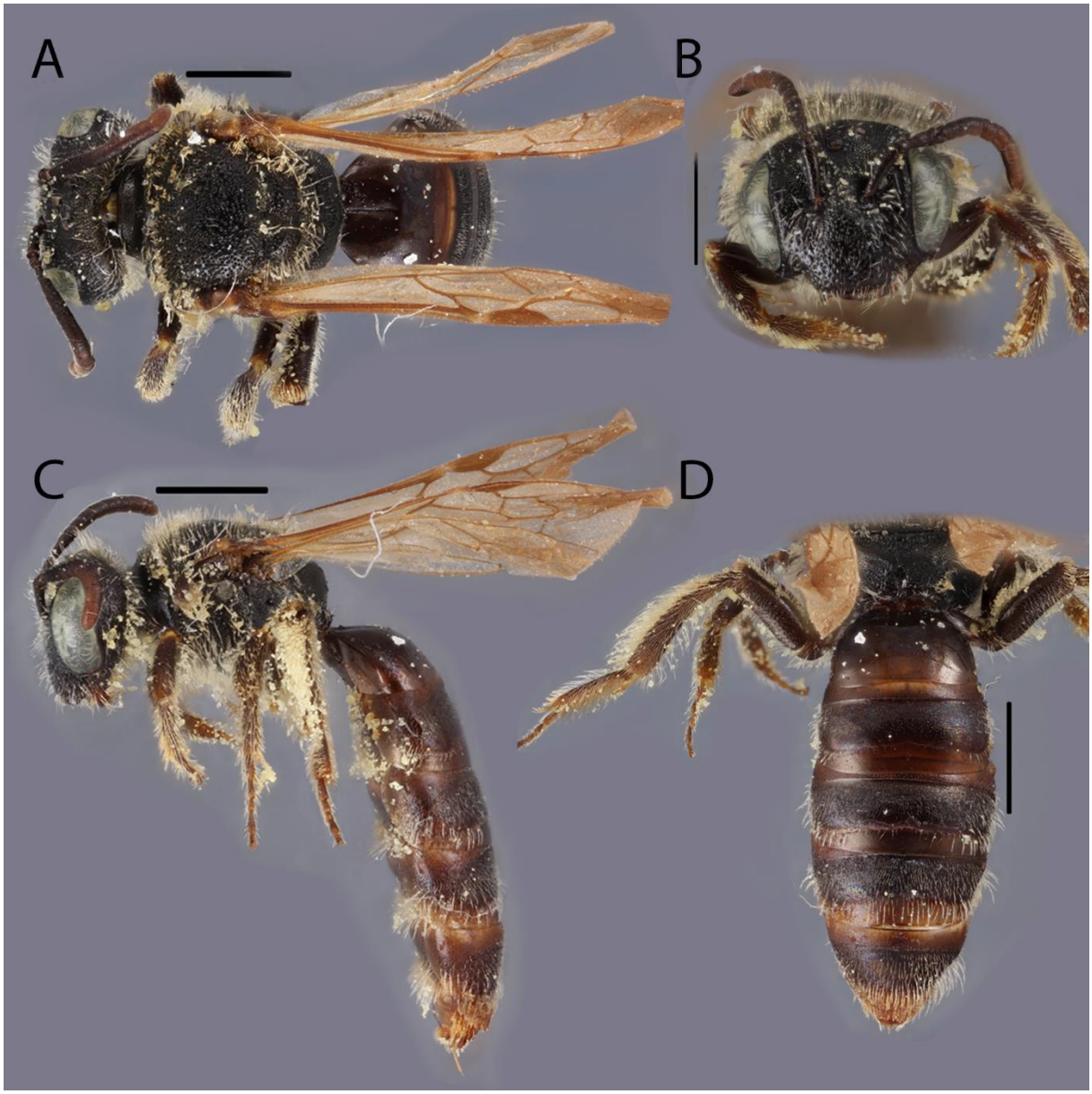


Figure 46. *Protandrena* (*Pterosarus*) *citripes*, ♀. AMNH_00292019. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena citripes* is active from early July to late September. Most floral records for the species come from the tribe Astereae, with specific preference for the genus

Heterotheca. However, the records are almost exclusively for males, with only one female floral record known for *Heterotheca subaxillaris*.

Range: Mexico (Guanajuato, Jalisco, Quere Taro, Sonora), USA (Arizona, Colorado, New Mexico).

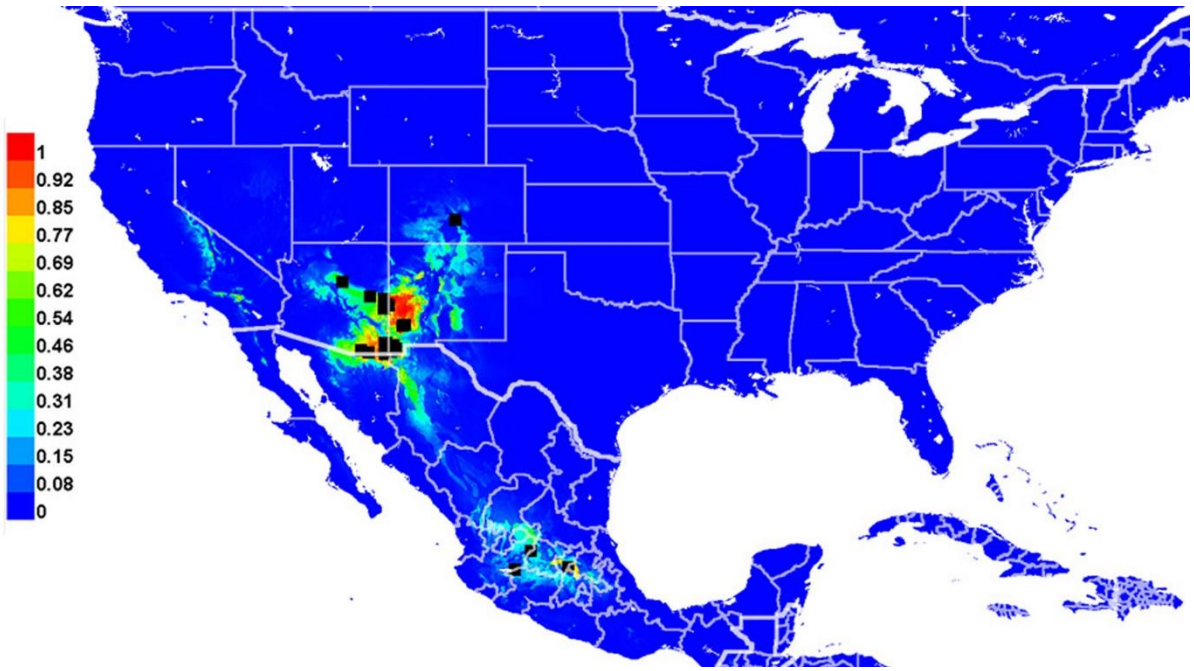


Figure 47. Georeferenced collection records of *Protandrena* (*Pterosarus*) *citripes* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *compositarum* (Robertson)**

(Figure 48, Figure 49)

Calliopsis compositarum Robertson, 1893: 274. ♀. Lectotype ♀ INHS: 8654. Lectotype designation by W. E. LaBerge in Webb (1980). Type locality: USA; Illinois, Macoupin Co., Carlinville (Robertson 1928). Examined specimen.

Taxonomy: Robertson, 1895: 123 (male description, diagnostic character). – Mitchell, 1960: 273–274 (redescription, key to eastern USA species).

Type specimens: Robertson (1893) described *Calliopsis compositarum* from two female syntypes. LaBerge in Webb (1980) designated one specimen from the INHS as the lectotype.

Diagnosis:

Both sexes of *Pr*. (*Pt*.) *compositarum* can be recognized by their rugulose scutum (contrast all other species).

Material examined:

CANADA – **Ontario** • 1♀; Essex, Ojibway Prairie Provincial Nature Reserve; [42.2595° N, 83.0616° W]; 13 Sep. 2018; Sharkey J. leg.; DEBU

USA – **Connecticut** • 1♀; New Haven, Cheshire, Boulder Knoll Farm; 41.4703° N, 72.8739° W; 01 Oct. 2009; Zarillo T. leg.; CAES – **Illinois** • 1♀; Champaign, Urbana, University of Illinois Woods; 40.1106° N, 88.2072° W; 10 Sep. 1891; Robertson C. leg.; INHS • 1♀; same location as preceding; 06 Sep. 1891; Robertson C. leg.; INHS • 1♀; Champaign; 40.2952° N, 87.9484° W; 06 Sep. 2019; Leonard R. leg.; ex *Solidago canadensis*; USDA IL • 1♀; same location as preceding; 06 Sep. 2019; Leonard R. leg.; ex *Solidago* rigida; USDA IL • 1♀; Falton, Rice Lake State Fish and Wildlife Area; [40.4685° N, 89.957° W]; 12 May. 1966; LaBerge W.E. leg.; ex *Symphyotrichum ericoides*; INHS • 4♀♀, 2♂♂; Fayette, Vandalia; 38.9606° N, 89.0936° W; 24 Sep. 1882; Robertson C. leg.; INHS • 1♀; Ford; 40.4443° N, 88.0211° W; 05 Sep. 2019; Leonard R. leg.; USDA IL • 1♀; Macoupin, Blackburn College; 39.2864° N, 89.87° W; 27 Sep. 2010; Portman Z. leg.; ex *Symphyotrichum pilosum*; INHS • 1♀; Macoupin, Brushy Mound

Road; 39.2498° N, 89.8767° W; 29 Sep. 2010; Wray J. leg.; ex *Symphyotrichum pilosum*; INHS • 1♀; same location as preceding; 29 Sep. 2010; Portman Z. leg.; ex *Symphyotrichum pilosum*; INHS • 20♀♀, 6♂♂; Macoupin, Carlinville; [39.2798° N, 89.8818° W]; 13 Sep. 1971; Marlin J.C. leg.; ex *Symphyotrichum pilosum*; INHS • 1♀, 7♂♂; same location as preceding; 08 Sep. 1971; Marlin J.C. leg.; ex *Symphyotrichum pilosum*; INHS • 11♀♀, 2♂♂; same location as preceding; 18 Sep. 1970; Marlin J.C. leg.; ex *Symphyotrichum pilosum*; INHS • 21♀♀, 2♂♂; same location as preceding; 19 Sep. 1970; Marlin J.C. leg.; ex *Symphyotrichum pilosum*; INHS • 1♀, 1♂; same location as preceding; 13 Sep. 1971; Marlin J.C. leg.; ex *Symphyotrichum ontarionis*; INHS • 16♀♀; same location as preceding; 02 Oct. 1970; Marlin J.C. leg.; ex *Symphyotrichum pilosum*; INHS • 2♀♀, 2♂♂; same location as preceding; 09 Sep. 1971; Marlin J.C. leg.; ex *Symphyotrichum pilosum*; INHS • 2♂♂; same location as preceding; 08 Sep. 1970; LaBerge, Marlin leg.; INHS • 1♀; same location as preceding; 25 Sep. 1970; Marlin J.C. leg.; ex *Symphyotrichum novae-angliae*; INHS • 34♀♀, 20♂♂; same location as preceding; Robertson C. leg.; INHS • 7♀♀; same location as preceding; 04 Oct. 1970; Marlin J.C. leg.; ex *Symphyotrichum pilosum*; INHS • 5♀♀; same location as preceding; 03 Oct. 1970; Marlin J.C. leg.; ex *Symphyotrichum pilosum*; INHS • 3♀♀; same location as preceding; 24 Oct. 1970; Marlin J.C. leg.; ex *Symphyotrichum pilosum*; INHS • 2♀♀; same location as preceding; 25 Sep. 1970; Marlin J.C. leg.; ex *Symphyotrichum pilosum*; INHS • 1♀; same location as preceding; 17 Oct. 1970; Marlin J.C. leg.; ex *Symphyotrichum pilosum*; INHS • 1♂; Macoupin, Carlinville; 39.2797° N, 89.8817° W; 13 Aug. 1897; Robertson C. leg.; INHS • 1♀; Macoupin, Carlinville; [39.2798° N, 89.8818° W]; 1898; Robertson C. leg.; INHS • 1♂; same location as preceding; 13 Aug. 1897; Robertson C. leg.; INHS • 3♂♂; Macoupin, Carlinville Lake Dam; 39.2448° N, 89.865° W; 17 Sep. 2010; Wray J. leg.; ex *Symphyotrichum pilosum*; INHS • 1♀; Macoupin,

Catatoga Road; 30.1943° N, 89.9578° W; 01 Oct. 2010; Portman Z. leg.; ex *Symphyotrichum pilosum*; INHS • 1♀; Macoupin, Corbin Hills; 39.246° N, 89.246° W; 23 Sep. 2010; Portman Z. leg.; ex *Symphyotrichum pilosum*; INHS • 1♂; Macoupin, Gallatin; [37.647° N, 88.2625° W]; 02 Oct. 1934; Rose, Frison leg.; INHS • 4♀♀; Macoupin, Gillespie Lake; 39.1506° N, 89.8682° W; 07 Oct. 2010; Portman Z. leg.; ex *Symphyotrichum pilosum*; INHS • 2♀♀; Macoupin, Hacke Road; 39.2086° N, 89.9244° W; 28 Sep. 2010; Wray J. leg.; ex *Symphyotrichum pilosum*; INHS • 2♀♀; same location as preceding; 28 Sep. 2010; Portman Z. leg.; ex *Symphyotrichum pilosum*; INHS • 1♀; Macoupin, Kirkland Road; 39.2901° N, 89.7859° W; 15 Sep. 2010; Portman Z. leg.; ex *Symphyotrichum pilosum*; INHS • 4♀♀; same location as preceding; 05 Oct. 2010; Portman Z. leg.; ex *Symphyotrichum pilosum*; INHS • 1♀; Macoupin, Moores Cemetary; 39.3056° N, 89.8184° W; 20 Sep. 2010; Portman Z. leg.; ex *Symphyotrichum pilosum*; INHS • 2♀♀; Macoupin, Rinaker Road; 39.2595° N, 89.9537° W; 06 Oct. 2010; Wray J. leg.; ex *Symphyotrichum pilosum*; INHS • 3♀♀; same location as preceding; 06 Oct. 2010; Portman Z. leg.; ex *Symphyotrichum pilosum*; INHS • 2♀♀; Macoupin, Spaulding Road; 39.1516° N, 89.854° W; 21 Sep. 2010; Portman Z. leg.; ex *Symphyotrichum pilosum*; INHS • 1♀; same location as preceding; 07 Oct. 2010; Wray J. leg.; ex *Symphyotrichum pilosum*; INHS • 2♀♀; Macoupin, Sumpter Road; 39.3108° N, 89.7698° W; 24 Sep. 2010; Portman Z. leg.; ex *Symphyotrichum pilosum*; INHS • 1♀, 1♂; same location as preceding; 24 Sep. 2010; Wray J. leg.; ex *Symphyotrichum pilosum*; INHS • 2♀♀; Macoupin, Tiels Road; 39.3156° N, 89.804° W; 20 Sep. 2010; Portman Z. leg.; ex *Symphyotrichum pilosum*; INHS • 5♀♀; same location as preceding; 20 Sep. 2010; Wray J. leg.; ex *Symphyotrichum pilosum*; INHS • 1♀; same location as preceding; 08 Oct. 2010; Wray J. leg.; ex *Symphyotrichum pilosum*; INHS • 2♀♀; same location as preceding; 08 Oct. 2010; Portman Z. leg.; ex *Symphyotrichum pilosum*; INHS • 1♂;

same location as preceding; 20 Sep. 2010; Portman Z. leg.; ex *Symphyotrichum pilosum*; INHS • 1♀; Vermilion; 40.2919° N, 87.9011° W; 11 Sep. 2019; Leonard R. leg.; ex *Symphyotrichum pilosum*; USDA IL • 1♀; same location as preceding; 11 Sep. 2019; Leonard R. leg.; USDA IL • 2♀♀; Vermilion; 40.1264° N, 87.812° W; 07 Sep. 2019; Leonard R. leg.; USDA IL • 1♂; INHS – **Indiana** • 1♀; Putnam, DePauw University; [39.64° N, 86.86° W]; 23 Sep. 1978; Johnson M.D. leg.; ex *Symphyotrichum* sp.; RJPC • 1♀; Vigo, Morris Lands; [39.5° N, 87.5° W]; 12 Oct. 2000; Jean R.P. leg.; ex *Symphyotrichum ericoides*; RJPC – **Kansas** • 1♀; Anderson, Garnett; [38.2806° N, 95.2419° W]; 25 Sep. 1949; Michener C.D., Beamer leg.; ex *Symphyotrichum* praealtum; SEMC • 1♀; Greenwood, Eureka; [37.8239° N, 96.2892° W]; 07 Sep. 1949; Michener C.D., Beamer leg.; ex *Amphiachyris* sp.; SEMC • 2♂♂; Woodson, Yates Center; [37.8811° N, 95.7333° W]; 07 Sep. 1949; Michener C.D., Beamer leg.; ex *Amphiachyris dracunuloides*; SEMC – **Maryland** • 1♀; Montgomery, Bethesda; [38.9807° N, 77.1003° W]; 23 Sep. 1914; Crawford J.C. leg.; CNC • 1♀, 1♂; same location as preceding; 14 Sep. 1913; Crawford J.C. leg.; AMNH • 1♂; same location as preceding; 23 Sep. 1913; Crawford J.C. leg.; AMNH • 3♂♂; Prince Georges, Beltsville; [39.0348° N, 76.9075° W]; 27 Sep. 1964; Arnaud P.H. leg.; CAS • 1♂; Somerset; [38.2169° N, 75.7528° W]; 12 Sep. 2016; Droege S.W. leg.; BIML – **Michigan** • 1♂; Ingham, Lansing, Collins Road; 42.692° N, 84.496° W; 01 Sep. 2015; Gibbs J. leg.; WRME • 1♀; Ingham, Mason; 42.437° N, 84.517° W; 07 Nov. 2014; Gibbs J. leg.; WRME • 1♀; Kalamazoo, Kalamazoo Nature Center; 42.354° N, 85.591° W; 05 Sep. 2013; Gibbs J. leg.; WRME – **Mississippi** • 1♀; Lafayette, Oxford; [34.3506° N, 89.6058° W]; 26 Sep. 1977; Lago P.K. leg.; MEM • 1♀, 1♂; Oktibbeha, Oktibbeha County Lake; [33.5088° N, 88.952° W]; 09 Oct. 1977; Cross W.H. leg.; MEM • 2♂♂; Oktibbeha, Starkville; [33.4563° N, 88.8672° W]; 27 Sep. 1981; Brown R.L. leg.; MEM • 1♂; same location as preceding; 03 Oct.

1981; Brown R.L. leg.; MEM • 1♂; same location as preceding; 20 Oct. 1982; Burnside B. leg.; MEM • 1♂; same location as preceding; 03 Oct. 1981; Brown R.L. leg.; MEM – **Missouri** • 1♀, 2♂♂; Miller, Ozark Lake; [38.1259° N, 92.8031° W]; 23 Sep. 1939; VanDyke E.G. leg.; CAS • 1♂; same location as preceding; 10 Sep. 1939; VanDyke E.G. leg.; CAS • 1♀; same location as preceding; 20 Sep. 1939; VanDyke E.G. leg.; CAS • 1♀; same location as preceding; 19 Sep. 1939; VanDyke E.G. leg.; CAS • 1♂; Wayne, Williamsville; [36.9712° N, 90.5496° W]; 08 Aug. 1988; Becker J.T. leg.; CNC – **New Jersey** • 1♂; Hudson, Kearny; [40.7684° N, 74.1454° W]; 31 Aug. 1933; Funaro C.W. leg.; AMNH • 1♀; Middlesex, Jamesburg; [40.3526° N, 74.4402° W]; Sep. 1920; AMNH • 1♀; Cape May; [39.1252° N, 74.7808° W]; 02 Oct. 2010; Van Dyke M. leg.; ex *Symphyotrichum pilosum*; RUIC: RW • 5♀♀; Princeton; [40.334° N, 74.6708° W]; 20 Sep. 2015; Roswell M. leg.; ex *Symphyotrichum racemosum*; RUIC: RW • 3♀♀; same location as preceding; 15 Sep. 2015; Roswell M. leg.; ex *Symphyotrichum racemosum*; RUIC: RW • 1♀; same location as preceding; 16 Sep. 2015; Roswell M. leg.; ex *Solidago nemoralis*; RUIC: RW • 5♀♀; same location as preceding; 16 Sep. 2015; Roswell M. leg.; ex *Symphyotrichum racemosum*; RUIC: RW • 3♀♀; same location as preceding; 25 Sep. 2015; Roswell M. leg.; ex *Symphyotrichum racemosum*; RUIC: RW • 1♀; [40.6956° N, 74.7558° W]; 11 Sep. 2015; ES leg.; ex *Symphyotrichum racemosum*; RUIC: RW – **New York** • 1♂; Richmond, New Dorp; [40.574° N, 74.116° W]; 30 Aug. 1934; Cazier M.A. leg.; AMNH • 1♀; Rockland, Tappan; [41.022° N, 73.9474° W]; 04 Sep. 1949; Rozen J.G. leg.; OSUC • 1♂; Suffolk, Gardiner's Island; [41.0944° N, 72.1001° W]; 23 Sep. 2005; Goelet R.G. leg.; AMNH • 2♀♀; Tompkins; [42.4576° N, 76.5488° W]; 14 Sep. 1958; Morse R.A. leg.; ex *Solidago* sp.; CUIC • 1♀; same location as preceding; 24 Aug. 1960; Ramdas J. leg.; ex *Solidago* sp.; CUIC • 1♀; same location as preceding; 26 Aug. 1960; Ramdas J. leg.; ex *Solidago* sp.; CUIC • 1♂;

Westchester, North Riverdale; [40.909° N, 73.9036° W]; 09 Sep. 1910; AMNH – **North Carolina** • 1♂; Buncombe, Black Mountain; [35.6179° N, 82.3212° W]; 09 Sep. 1906; Beutenmuller W. leg.; AMNH • 3♀♀; same location as preceding; 1911; AMNH • 1♂; Haywood, Great Smoky Mountains National Park; [35.6131° N, 83.5532° W]; 06 Sep. 1953; Kessel E.L. leg.; CAS • 2♂♂; McDowell; 37° N, 81.3° W; 09 Sep. 1987; BRC HYM TEAM MT leg.; CNC • 1♂; Wake, Raleigh; [35.7721° N, 78.6386° W]; 21 Oct. 1945; Mitchell T.B. leg.; UMSP • 1♀; same location as preceding; 31 Oct. 1937; Mitchell T.B. leg.; UMSP • 1♂; Watauga, New River; [34.7574° N, 77.4097° W]; 08 Sep. 1944; Bohart G. leg.; AMNH – **Ohio** • 3♀♀; Ashland, Sullivan; [41.0244° N, 82.1991° W]; 15 Sep. 2020; Laura J. Weber leg.; OSUC: KG • 1♀; Brown, Georgetown; [38.9086° N, 83.8591° W]; 30 Sep. 2020; Hannah Scott leg.; OSUC: KG • 1♀; Clinton, Wilmington; [39.3815° N, 83.9027° W]; 05 Oct. 2020; Roxanne Luff leg.; OSUC: KG • 1♀; Delaware, Delaware; [40.257787° N, 83.0708° W]; 06 Oct. 2020; Winstel D. leg.; OSUC: KG • 1♀; same location as preceding; 14 Sep. 2020; Winstel D. leg.; OSUC: KG • 1♀; Delaware, Lewis Center; [40.1708° N, 82.9635° W]; 02 Oct. 2020; Staats T. leg.; OSUC: KG • 1♀; same location as preceding; 18 Sep. 2020; Staats T. leg.; OSUC: KG • 1♀; Hancock, Findlay; [41.0181° N, 83.693° W]; 01 Oct. 2020; Chad Carroll leg.; OSUC: KG • 1♂; Hocking, Rockbridge; [39.4918° N, 82.5831° W]; 07 Sep. 2020; Miranda Caw, Katie leg.; OSUC: KG • 2♀♀; same location as preceding; 29 Sep. 2020; Moosbrugger J. leg.; OSUC: KG • 1♀; Holmes, Millersburg; [40.5022° N, 81.9073° W]; 23 Sep. 2020; Pat Dutton leg.; OSUC: KG • 1♀; Huron, Norwalk; [41.275347° N, 82.56927° W]; 23 Sep. 2020; Charlene Margetiak leg.; OSUC: KG • 1♀; Portage, Morgan Park; [41.2312° N, 81.2273° W]; 05 Sep. 2021; Heath B. leg.; ex *Symphyotrichum* sp.; OSUC: KG • 1♀; Summit, Twinsburg; [41.312681° N, 81.4174° W]; 11 Sep. 2020; Marcia Carsten leg.; OSUC: KG • 1♀; Washington, Elk Run; [39.5001° N, 81.2486°

W]; 02 Sep. 2021; Laura Hughes leg.; ex *Bidens trichosperma*; OSUC: KG • 1♀; same location as preceding; 27 Sep. 2021; Laura Hughes leg.; ex *Symphyotrichum prenanthoides*; OSUC: KG • 5♀♀; Wayne, Wooster; [40.8109° N, 82.0196° W]; 10 Sep. 2020; Boyer P. leg.; OSUC: KG • 1♀; same location as preceding; 07 Oct. 2020; Boyer P. leg.; OSUC: KG • 2♀♀; same location as preceding; 21 Sep. 2020; Boyer P. leg.; OSUC: KG • 1♀; Wayne, Wooster; [40.7982° N, 82.0319° W]; 18 Sep. 2021; Boyer P. leg.; ex *Symphyotrichum pilosum*; OSUC: KG – **Oklahoma** • 2♀♀; Cleveland, Norman, University of Oklahoma; [35.1901° N, 97.4496° W]; 13 Sep. 2021; Hung K.L.J. leg.; ex *Symphyotrichum subulatum*; OMNH: JH • 2♀♀; Tulsa, Jenks, Arkansas River; [36.0159° N, 95.9571° W]; 24 Sep. 2021; Hung K.L.J. leg.; ex *Symphyotrichum subulatum*; OMNH: JH – **Pennsylvania** • 10♀♀; Centre, State College Musser Gap Trail; [40.7672° N, 77.8615° W]; 28 Sep. 2020; Selking R. leg.; ex *Symphyotrichum* sp.; PSUC • 2♀♀, 1♂; Centre, State College Scotia Barrens, St. Game lands no. 176; [40.7852° N, 77.95° W]; 15 Sep. 2020; Selking R. leg.; ex *Symphyotrichum* sp.; PSUC • 1♀; Columbia, Bloomsburg; [40.4295° N, 76.0133° W]; 30 Sep. 1914; AMNH – **Virginia** • 1♂; Fairfax, Rock Hill District Park, dog park path south of parking lot; [38.8777° N, 77.4732° W]; 06 Oct. 2020; Latham O.C. leg.; VADCR • 1♂; Montgomery, Blacksburg; [37.8187° N, 79.3192° W]; elev. 1000 m.; 01 Sep. 1987; BRC HYM TEAM MT leg.; CNC – **Washington D.C**. • 1♂; [38.9577° N, 77.0476° W]; 16 Sep. 1956; Arnaud P.H. leg.; CAS

Description

Male:

Structure: Body length range 5.3–6.1 mm. Head broader than long (HL/HW ratio 0.83). Face below antennae convex. Labral process trapezoidal, broader than long, apex emarginate. Clypeus

without median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.34). Posterior ocelli 0.28 mm apart. Flagellomeres longer than broad. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.02 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.15 mm. S6 notch deep, extending approximately 1/2 of disk, lateral carina absent.

Sculpture: Clypeus punctation coarse and dense (IS < 1 PD). Paraocular punctation coarse and dense (IS < 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 0.5 MOD from dorsal tangent of antennal socket. Frons finely reticulate. Vertex coarsely reticulate. Mesoscutum punctation rugulose. Scutellum punctation coarsely reticulate. Mesopleuron punctation coarse and dense posteriorly (IS < 1 PD) coarsely reticulate anteriorly. Lateral propodeum punctation rugose. Posterior propodeum rugose. Posterior propodeum not microsculptured. Dorsal face of T1 punctation fine and dense (IS < 1 PD). T2 basal impression deep, basal 1/2 of T2 lineolate. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus yellow. Supraclypeal area yellow to within 1 MOD of antennal socket. Lower paraocular area yellow to within 1 MOD of antennal socket. Labral process yellow. Mandible yellow. Scape black. Flagellomeres dark. Pronotal lobe black. Tegula light brown. Wing veins and stigma brown, membrane light brown. Fore tibia yellow anteriorly dark posteriorly, mid and hind tibia with reduced dark spot medially, yellow apically and basally. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity medium-length, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium

length, sparse. S4 pubescence medium length, sparse. S5 pubescence long, medially directed apicolateral fringes.

Female:

Structure: Body length range 6.15–6.9 mm. Head broader than long (HL/HW ratio 0.81). Face below antennae convex. Labral process trapezoidal, broader than long, apex rounded. Clypeus without median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.07). Posterior ocelli 0.34 mm apart. Flagellomeres slightly broader than long. Dorsal pronotal carina present laterally but not medially. Prosternum not produced. ITD 1.41 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.063 mm.

Sculpture: Clypeus punctation coarse and sparse anteriorly (IS = 1 – 2 PD) finer and denser posteriolaterally (IS < 0.5 PD). Paraocular punctation coarse and sparse (IS = 1 PD). Supraclypeal area punctation fine and sparse (IS = 2 - 3 PD). Fovea clavate. Foveae weakly converging above, narrow end terminating along midline of antennal socket. Frons punctation reticulate. Vertex punctation reticulate. Mesoscutum punctation rugulose. Scutellum punctation reticulate. Mesopleuron punctation reticulate along borders, rugose medially. Lateral propodeum punctation rugose. Posterior propodeum rugose. Posterior propodeum tessellate. Dorsal face of T1 punctation fine and dense (IS < 0.5 PD) impunctate medially. T2 basal impression shallow, approximately 1/2 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation lineolate.

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F4-F8 orange ventrally. Pronotal lobe black.

Tegula light brown. Wing veins, stigma, and membrane light brown. Fore and mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity medium-length, yellow/brown. Scutellum pilosity long, yellow. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium length, sparse. S4 pubescence medium length, sparse. S5 pubescence medium length, medially directed apicolateral fringes.

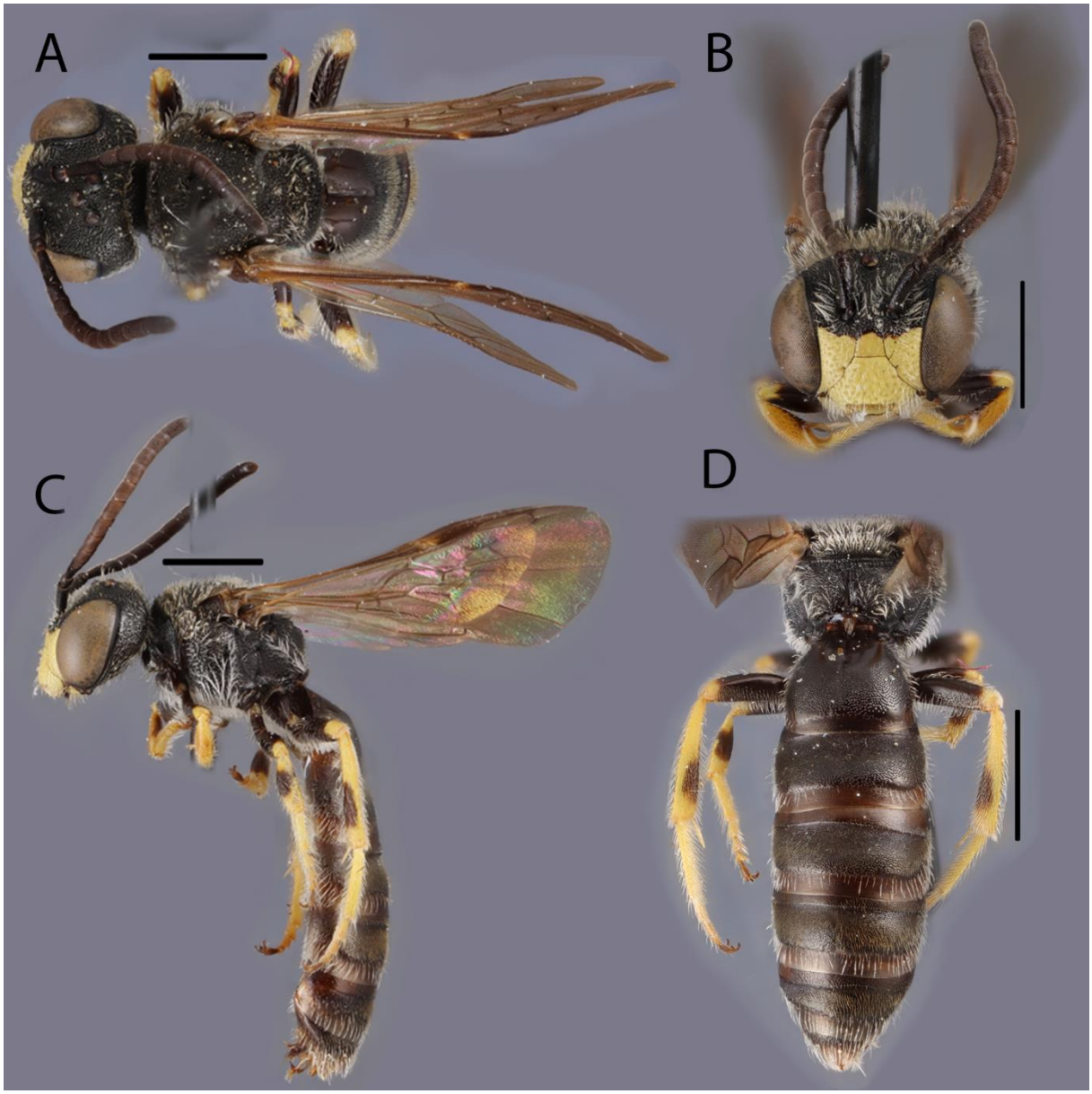


Figure 48. *Protandrena* (*Pterosarus*) *compositarum*, ♂. INHS_842826. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

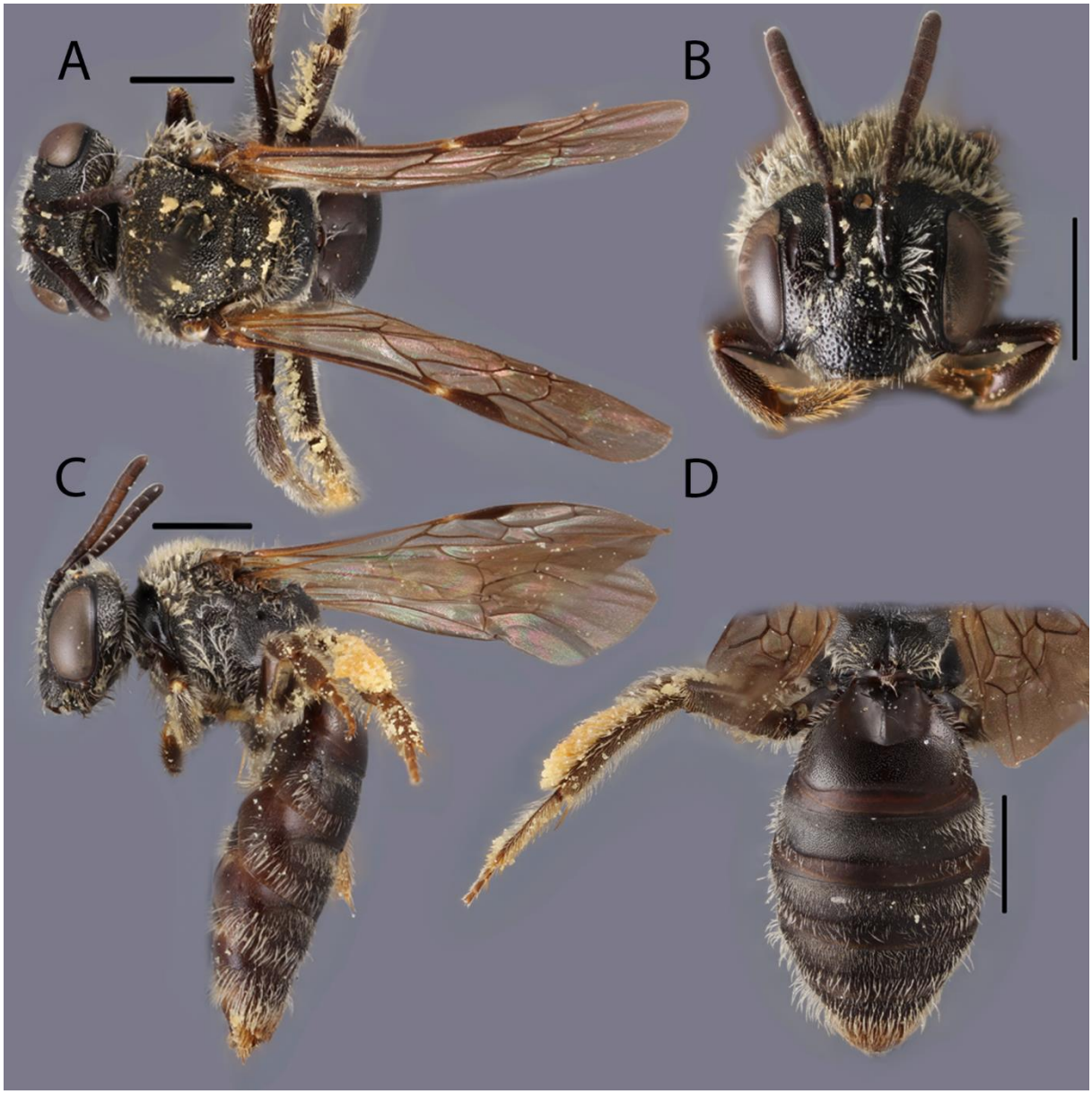


Figure 49. *Protandrena* (*Pterosarus*) *compositarum*, ♀. INHS_842810. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena compositarum* is active from late August into early November (with one record as early as May). Most floral records come from the tribe Astereae, with a specific preference shown for the genus *Symphyotrichum*.

Range: Canada (southern Ontario), USA (Connecticut, Illinois, Indiana, Kansas, Maryland, Michigan, Mississippi, Missouri, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Virginia).

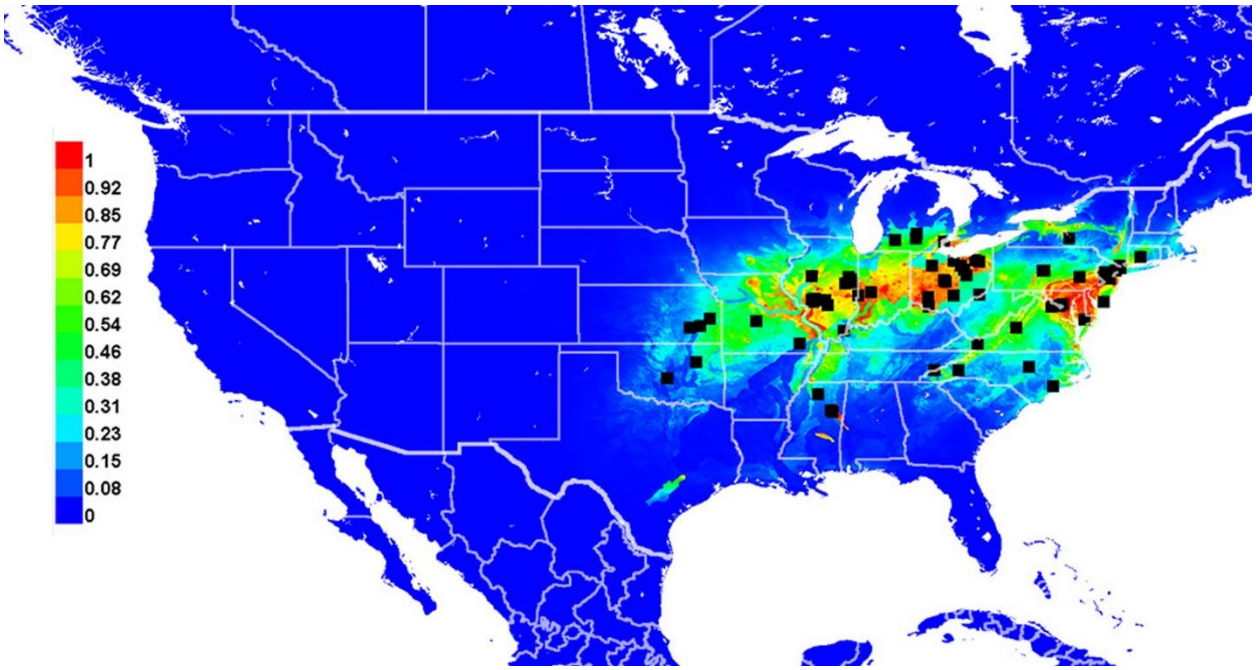


Figure 50. Georeferenced collection records of *Protandrena* (*Pterosarus*) *compositarum* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *didirupa* (Cockerell)**

(Figure 51, Figure 52)

Panurginus didirupa Cockerell, 1908: 293. ♂♀. Holotype ♂ CAS 15414. Type locality: USA; Colorado: North Boulder Creek: 21 Aug 1907. Examined by photos.

Pseudopanurgus diderupa (!): Timberlake 1967: 11 (lapsus calami).

Panurginus pulchricornis Cockerell, 1922: 8. ♀ Holotype ♀ AMNH: 323876. Type locality: USA; Colorado: Tennessee Pass. 6–8 Aug 1920. 10500 ft. **New Synonymy**. Examined by photos.

Type specimens: Cockerell (1908) described the male and female of *Panurginus didirupa* and designated the male specimen as the holotype. Cockerell (1922) described *Panurginus pulchricornis* from a single female and did not compare to specimens of *Panurginus didirupa.* Comparison of *Panurginus didirupa* females and the type of *Panurginus pulchricornis* finds them to be the same morphologically, and that the type locality of *Panurginus pulchricornis* falls well within the expected range of *Panurginus didirupa*.

Diagnosis:

Males of *Pr*. (*Pt*.) *didirupa* can be recognized by a combination of their sparse scutum punctures that are denser on posterior border (contrast all except: *Pr. irregularis*, *Pr. luxsolaris*, *Pr. prata*), and dark scape (contrast remaining).

Females of *Pr*. (*Pt*.) *didirupa* can be recognized by a combination of their dark flagella (contrast all except: *Pr. barberi*, *Pr. citripes*, *Pr. nudescens*, *Pr. ehnesae*, *Pr. ximenesiae*) and coarse sparse scutum punctures (IS > 3 PD) (contrast *nudescens* citripes barberi) and broadly trapezoidal labral process (contrast remaining).

Material examined:

USA – **Colorado** • 1♀; Boulder, Altona (3 mi. SW); [40.1052° N, 105.3285° W]; 07 Sep. 1962; Lanham U.N., Vogel B. leg.; UCMC • 1♂; Boulder, Eldora; [39.9486° N, 105.5639° W]; 19 Aug.; Cockerell T.D.A. leg.; UCMC • 1♀; Boulder, Eldora; 39.949° N, 105.564° W; elev. 2461 m.; 19 Aug.; Cockerell T.D.A., Cockerell W.P. leg.; ex *Grindelia* sp.; UCMC • 1♀; Boulder, Eldora; [39.9486° N, 105.5639° W]; 19 Aug. 1910; Cockerell T.D.A. leg.; ex *Grindelia* sp.; CAS • 1♂; Boulder, Eldorado Springs; 39.932° N, 105.277° W; elev. 1752 m.; 04 Aug. 1962; Lanham U.N. leg.; ex *Grindelia* sp.; UCMC • 1♂; Boulder, Jamestown (4 mi. W); 40.125° N, 105.4614° W; elev. 2591 m.; 06 Aug. 1962; Sutton S.M. leg.; UCMC • 2♂♂; same location as preceding; 06 Aug. 1962; Lanham U.N. leg.; UCMC • 1♂; Boulder, North Boulder Creek; [40.0051° N, 105.5466° W]; 21 Aug. 1908; Cockerell T.D.A. leg.; CAS • 1♀; Boulder, North Boulder Creek, Canadian Zone; [40.0051° N, 105.5466° W]; 22 Aug. 1907; Rohwer S.A. leg.; CAS • 1♀; Boulder, Science Lodge, W.; 40.0321° N, 105.5358° W; elev. 2789-3018 m.; 12 Aug. 1939; Lanham U.N. leg.; UCMC • 1♂; Boulder, Ward; 40.0667° N, 105.55° W; elev. 2835 m.; 08 Aug. 1919; AMNH • 2♂♂; Boulder, Ward (2 mi. SW); 40.0517° N, 105.5351° W; elev. 2743 m.; 08 Aug. 1962; Lanham U.N., Vogel B. leg.; UCMC • 1♀; Boulder; [40.01499° N, 105.27055° W]; 27 Jul. 1925; Custer C.P. leg.; UCMC • 1♀; same location as preceding; 01 Aug. 1925; Custer C.P. leg.; UCMC • 1♂; Boulder , Nederville; [39.9614° N, 105.5108° W]; 07 Aug. 1961; Stainer J.E.R. leg.; CNC • 10♂♂; Clear Creek, Georgetown; 39.7167° N, 105.6833° W; elev. 2600 m.; 20 Aug. 2001; Irwin M.E., Lamkin C., Metz M., Hauser M. leg.; BBSL • 1♂; El Paso, Colorado Springs, Rock Creek; [39.9361° N, 105.1564° W]; 19 Aug. 1937; AMNH • 1♀; Freemont, Coaldale (5 mi. S); [38.3656° N, 105.7578° W]; elev. 2225 m.; 13 Aug. 1969; Michener C.D. leg.; SEMC • 1♀; Garfield, Carbondale (7 mi. NE); 39.473° N, 107.118° W; elev. 2245 m.; 07 Aug. 1982; Lanham U.N. leg.; ex *Solidago* sp.; UCMC • 1♂; Gilpin, Gilpin, Lump Gulch near

Gilpin; 39.8865° N, 105.5049° W; elev. 2743-3353 m.; 28 Aug. 1946; Rodeck H.G. leg.; UCMC • 1♀, 2♂♂; Gunnison, Almont; [38.6647° N, 106.8462° W]; 30 Jul. 1984; Eickwort G.C. leg.; CUIC • 1♀, 1♂; same location as preceding; 26 Jul. 1988; Eickwort G.C. leg.; CUIC • 1♀; same location as preceding; 01 Jul. 1984; Eickwort G.C. leg.; CUIC • 1♂; Gunnison, Gothic, Rocky Mountain Biological Laboratory; [38.9585° N, 106.9899° W]; 31 Jul. 1984; Eickwort G.C. leg.; CUIC • 4♀♀, 2♂♂; same location as preceding; 18 Jul. 1988; Eickwort G.C. leg.; CUIC • 2♀♀; same location as preceding; 29 Jul. 1984; Eickwort G.C. leg.; CUIC • 1♀; same location as preceding; 22 Jul. 1984; Eickwort G.C. leg.; CUIC • 4♀♀, 1♂; Larimer, Chicken Park (3 mi. NW); 40.92118° N, 105.57399° W; elev. 2505 m.; 20 Jul. 2000; Hicks A.L., Scott V., delaFuente M. leg.; ex *Grindelia* sp.; UCMC • 1♀, 1♂; Larimer, Estes Park; [40.3772° N, 105.5217° W]; 08 Aug. 1974; Favreau M., Favreau T.M. leg.; AMNH • 1♀, 1♂; Larimer, Fort Collins, Poudre Canyon; 40.7007° N, 105.5575° W; 08 Aug. 1934; Dodelinger N. leg.; UCMC • 1♀; Mesa, Cedaredge (20 mi. N), Highway 65 near Kannah Creek (2 mi. W); [39.0731° N, 108.1727° W]; elev. 3170 m.; 28 Jul. 1976; Herman N.L. leg.; AMNH • 1♀; Mesa, Mesa (8 mi. S); [39.0366° N, 108.1353° W]; 12 Jul. 1938; Lanham U.N. leg.; UCMC • 1♂; Mineral, Creede; [37.8492° N, 106.9264° W]; Aug. 1914; Hunter S.J. leg.; SEMC • 1♂; Montezuma, Mesa Verde National Park; [37.2309° N, 108.4618° W]; elev. 2438 m.; 08 Aug. 1957; Michener C.D. leg.; SEMC • 1♀; Montrose, Gunnison National Monument, Black Canyon; [38.5754° N, 108.0217° W]; 19 Jul. 1984; Eickwort G.C. leg.; CUIC • 2♀♀; Montrose; 38.4114° N, 108.6034° W; elev. 2438 m.; 17 Sep. 1975; Lanham U.N. leg.; ex *Symphyotrichum* Sp.; UCMC • 3♀♀; Park, 11-Mile Canyon; [38.9067° N, 105.47° W]; elev. 2438 m.; 15 Jul. 1954; Evans H.E., Evans M.A. leg.; CUIC • 2♀♀; Pitkin, Ashcroft; 39.0536° N, 106.7992° W; elev. 2743 m.; 26 Jul. 1964; Lanham U.N. leg.; UCMC • 1♂; Sanders, Rainbow Lake; [39.5628° N, 106.0877° W]; 02 Aug.

1950; Malkin B. leg.; CAS • 1♂; Summit, Frisco (1 mi. W); 39.5673° N, 106.1246° W; elev. 2804 m.; 25 Jul. 1962; Lanham U.N. leg.; UCMC • 1♂; Teller, Florissant, Florissant Fossil Beds; 38.90928° N, 105.29327° W; elev. 2560 m.; 26 Jul. 1984; Brown F.M. leg.; ex *Achillea millefolium*; UCMC • 1♂; Estes Park; [40.377° N, 105.523° W]; 21 Aug. 1946; Fluke C.L. leg.; WIRC • 1♀; Tennessee Pass; [39.3214° N, 106.3286° W]; 06 Aug. 1920; Cockerell T.D.A. leg.; AMNH – **Montana** • 1♀; Powell, Deer Lodge; [46.3958° N, 112.73° W]; 21 Jul. 1968; Deyrup M.A. leg.; CUIC – **Nevada** • 2♀♀; Elko, Carlin (4 mi. N); [40.7138° N, 116.104° W]; 12 Jun. 1932; Beamer R.H., Beamer L.D., Welner, Wolf, LaBerge, Liang, leg.; SEMC – **New Mexico** • 1♂; Catron, Gila National Forest, Frisco Spring; 33.6457° N, 107.7927° W; 29 Aug. 2009; Griswold T.L. leg.; BBSL • 1♂; McKinley, Gallup; [35.5281° N, 108.7426° W]; 31 Aug. 1934; Lutz F.E. leg.; AMNH • 1♀; Rio Arriba, Jarosa Spring Canyon, Coyote (11 mi. SW); [36.0586° N, 106.7549° W]; elev. 2621 m.; 11 Aug. 1965; Leech H.B. leg.; CAS – **Utah** • 1♀; Cache, Tony Grove Lake (1.2 mi. N); 41.9128° N, 111.6435° W; elev. 2591 m.; 24 Aug. 2006; Messinger O.J. leg.; BBSL • 1♂; Garfield, Blubber Creek Junction, Right Fork; [37.5472° N, 112.3008° W]; 20 Jul. 2000; Sommers M. leg.; ex *Chrysothamnus* sp.; BBSL • 1♂; Garfield, Bown's Point (1.8 mi. SE); [38.0409° N, 111.3403° W]; 30 Jul. 2002; Messinger S. leg.; ex *Chrysothamnus depressus*; BBSL • 2♀♀, 1♂; Garfield, Deer Creek Lake (1.8 mi. S); [38.0136° N, 111.385° W]; 30 Jul. 2002; Messinger S. leg.; ex *Chrysothamnus depressus*; BBSL • 1♂; same location as preceding; 30 Jul. 2002; Topham L. leg.; ex *Gutierrezia sarothrae*; BBSL • 1♂; Garfield, Highway 12 Upper Valley, South rim (0.5 mi. W); [37.7649° N, 111.6837° W]; 19 Aug. 2002; Richmond J. leg.; ex *Gutierrezia sarothrae*; BBSL • 1♂; Garfield, Junction of Johnson Hollow and E Fork Sevier River; [37.6452° N, 112.2325° W]; 20 Jul. 2000; Sellars R. leg.; ex Asteraceae sp.; BBSL • 2♀♀; Garfield, Oak Creek, Boulder Mountain; 38.0885° N,

111.3435° W; 05 Sep. 2008; Griswold T.L. leg.; BBSL • 2♂♂; Garfield, Panguitch Lake; [37.7171° N, 112.6503° W]; elev. 2499 m.; 30 Jul. 1973; Eickwort G.C. leg.; CUIC • 1♀; Garfield, Pearl Flat; [38.0892° N, 110.7866° W]; 08 Aug. 2001; Andrus R. leg.; ex Cirsium sp.; BBSL • 1♂; Garfield, Pearl Flat (1 mi. NW); [38.1028° N, 110.7807° W]; 08 Aug. 2001; Messinger O., Messinger S. leg.; BBSL • 1♀; Garfield, Point Lookout; [37.3637° N, 109.9972° W]; 30 Jul. 2002; Messinger S. leg.; ex *Senecio* spartioides; BBSL • 1♀; Grand, Warner Ranger Station; [38.52° N, 109.2748° W]; elev. 2926 m.; 02 Aug. 1960; Rindge F., Rindge P., Rindge B. leg.; AMNH • 1♂; Kane, Boy Scout Spring, Navajo Lake; [37.5261° N, 112.7755° W]; 20 Aug. 2002; Messinger O.J. leg.; ex *Erechtites sonchoides*; BBSL • 1♂; same location as preceding; 20 Aug. 2002; Messinger S. leg.; ex *Symphyotrichum* sp.; BBSL • 1♂; Kane, Duck Creek; [37.5236° N, 112.663° W]; 26 Jul. 1968; Knowlton G.F. leg.; UMSP • 1♂; Kane, Highway 14 , Strawberry Knolls (0.75 mi. W); [37.5149° N, 112.6406° W]; 20 Aug. 2002; Messinger S. leg.; ex *Heliomeris multiflora*; BBSL • 2♂♂; Summit, Kamas, Cobble Creek (24 km E); [40.5904° N, 110.6896° W]; 02 Jul. 1987; Spanton T.G. leg.; PMAE • 1♂; Wasatch, Soldier summit; [39.9286° N, 111.0779° W]; 13 Aug. 1936; Jackson M.B. leg.; SEMC – **Wyoming** • 1♀; Albany, Boulder Ridge, Tie Siding (4.5 mi. SW); [41.0567° N, 105.5901° W]; 29 Jul. 1976; Tepedino V.J. leg.; INHS • 3♀♀; same location as preceding; 31 Jul. 1975; Tepedino V.J. leg.; INHS • 2♀♀; same location as preceding; 13 Aug. 1976; Tepedino V.J. leg.; INHS • 1♀; same location as preceding; 19 Aug. 1976; Tepedino V.J. leg.; INHS • 3♀♀, 1♂; same location as preceding; 05 Aug. 1976; Tepedino V.J. leg.; INHS • 1♂; same location as preceding; 22 Jul. 1976; Tepedino V.J. leg.; INHS • 1♀; Albany, Tie Siding (4.5 mi SW), Boulder Ridge; [41.041° N, 105.5746° W]; 29 Jul. 1976; Tepedino V.J. leg.; ex *Heterotheca villosa*; INHS • 3♀♀; same location as preceding; 31 Jul. 1975; Tepedino V.J. leg.; ex *Erigeron* canus; INHS • 2♀♀; same

location as preceding; 13 Aug. 1976; Tepedino V.J. leg.; ex *Gutierrezia sarothrae*; INHS • 1♀; same location as preceding; 19 Aug. 1976; Tepedino V.J. leg.; ex *Heterotheca villosa*; INHS • 4♀♀; same location as preceding; 05 Aug. 1976; Tepedino V.J. leg.; ex *Heterotheca villosa*; INHS • 1♀; same location as preceding; 22 Jul. 1976; Tepedino V.J. leg.; ex *Heterotheca villosa*; INHS • 1♀; Carbon, Baggs; [41.0358° N, 107.6576° W]; 02 Sep. 1959; Fronk W.D. leg.; ESUW • 1♀; Fremont, Shoshoni; [43.2358° N, 108.1104° W]; 29 Jun. 1965; Holland F.R. leg.; ESUW

Description

Male:

Structure: Body length range 5.5–6.8 mm. Head broader than long (HL/HW ratio 0.86). Face below antennae convex. Labral process trapezoidal, broader than long, apex emarginate. Clypeus without median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.27). Posterior ocelli 0.28 mm apart. Flagellomeres broader than long. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.1 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.16 mm. S6 notch broad about 1/2 as broad as deep which is 3/4 of disk, lateral carina absent.

Sculpture: Clypeus punctation coarse and dense (IS < 1 PD). Paraocular punctation coarse and dense (IS < 1 PD). Supraclypeal area punctation fine and sparse (IS = 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 0.5 MOD from dorsal tangent of antennal socket. Frons finely reticulate. Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation coarse and sparse (IS > 1 PD) denser posteriorly (IS < 1 PD). Scutellum punctation coarse and sparse laterally (IS = 1 PD) denser medially (IS < 1 PD). Mesopleuron punctation coarse and sparse (IS = 1 PD). Lateral propodeum finely reticulate. Posterior propodeum finely

reticulate. Posterior propodeum not microsculptured. Dorsal face of T1 punctation fine and sparse (IS = 1 PD). T2 basal impression deep, basal 2/3 of T2 lineolate. T3 punctation dense (IS < 1 PD). T4 punctation sparse (IS = 1 PD).

Colour: Clypeus yellow. Supraclypeal area yellow to within 1 MOD of antennal socket. Lower paraocular area yellow to within 1.5 MOD of antennal socket medially, extends along compound eye terminating 0.5 MOD from ventral tangent of antennal socket. Labral process yellow. Mandible yellow. Scape black. Flagellomeres dark. Pronotal lobe black. Tegula light brown. Wing veins and stigma brown, membrane hyaline. Fore tibia yellow anteriorly dark posteriorly, mid tibia narrowly yellow apically and basally, hind tibia yellow at knee. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity long, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium length, sparse. S4 pubescence medium length, sparse. S5 pubescence long, medially directed apicolateral fringes.

Female:

Structure: Body length range 6.13–7.01 mm. Head broader than long (HL/HW ratio 0.86). Face below antennae convex. Labral process broadly trapezoidal, broader than long, apex rounded. Clypeus with median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.06). Posterior ocelli 0.31 mm apart. Flagellomeres broader than long. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.27 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.067 mm.

Sculpture: Clypeus punctation coarse and dense (IS < 1 PD). Paraocular punctation coarse and dense (IS < 1 PD). Supraclypeal area punctation fine and sparse (IS = 1 PD). Fovea clavate.

Foveae converging above, narrow end terminating 1/2 way down antennal socket. Frons punctation fine and dense (IS < 1 PD). Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation coarse and sparse (IS > 3 PD). Scutellum punctation coarse and sparse laterally (IS = 1 PD) denser medially (IS < 1 PD). Mesopleuron punctation fine and sparse (IS = 1 PD). Lateral propodeum finely reticulate. Posterior propodeum finely reticulate. Posterior propodeum not microsculptured. Dorsal face of T1 punctation fine and sparse (IS > 1 PD). T2 basal impression shallow, basal 1/2 of T2 lineolate. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres dark. Pronotal lobe black. Tegula light brown. Wing veins and stigma brown, membrane hyaline. Fore and mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, yellow. Scutellum pilosity long, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium length, sparse. S4 pubescence medium length, sparse. S5 pubescence long, medially directed apicolateral fringes.

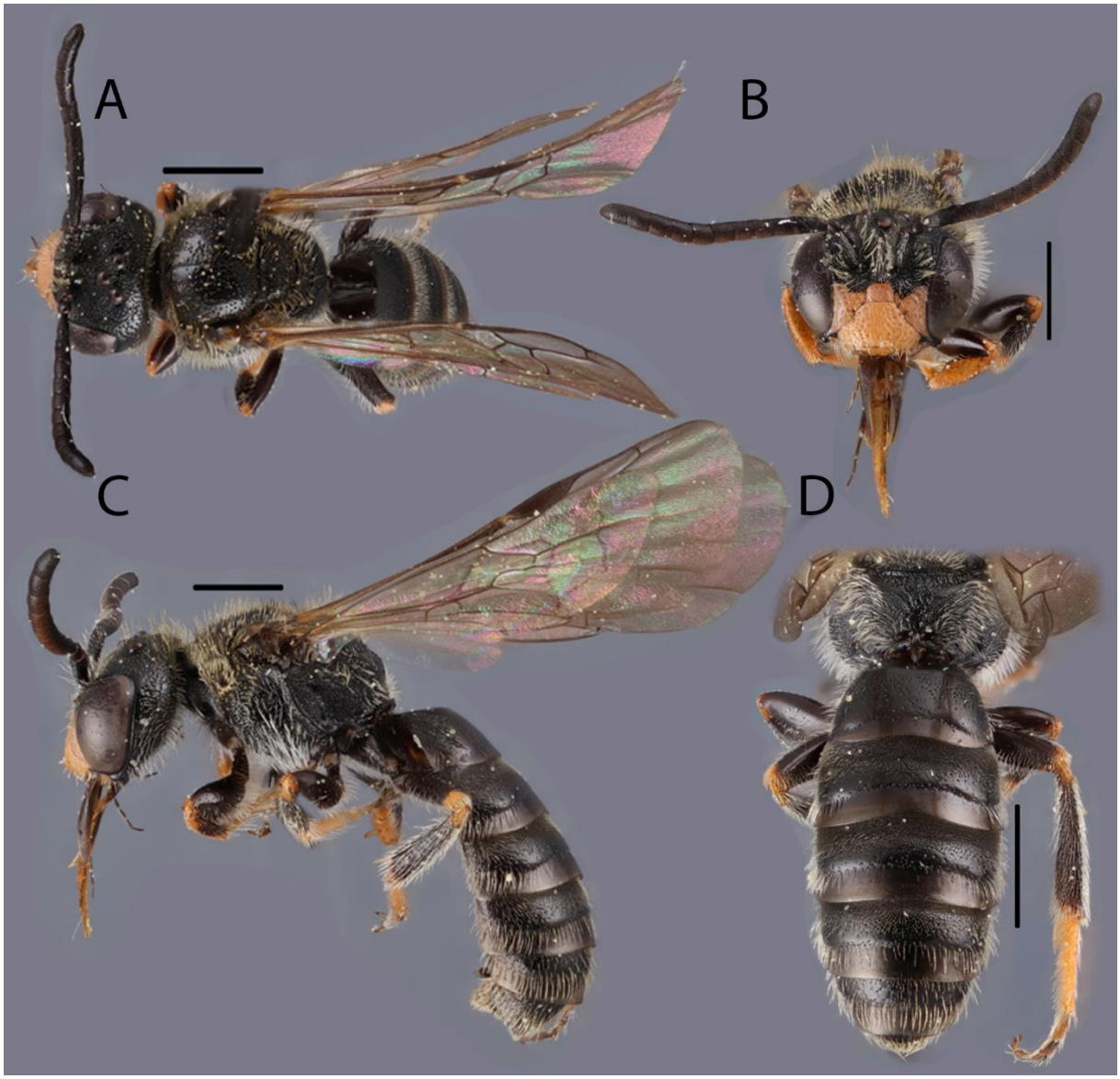


Figure 51. *Protandrena* (*Pterosarus*) *didirupa*, ♂. UCMC_221463. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

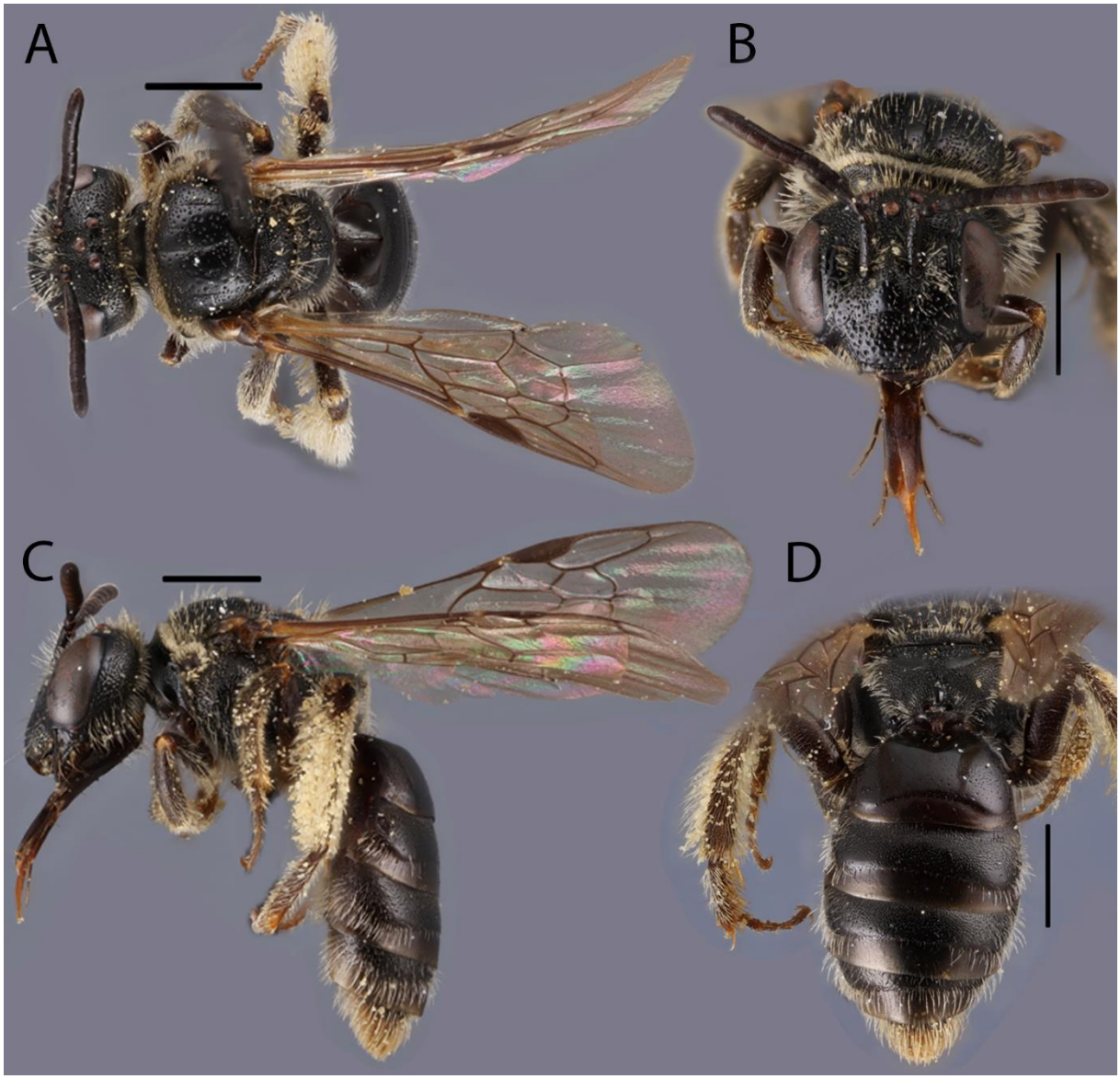


Figure 52. *Protandrena* (*Pterosarus*) *didirupa*, ♀. UCMC_221465. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena didrupa* is active from mid-June to early September. Most floral records for the species come from Astereae.

Range: USA (Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming).

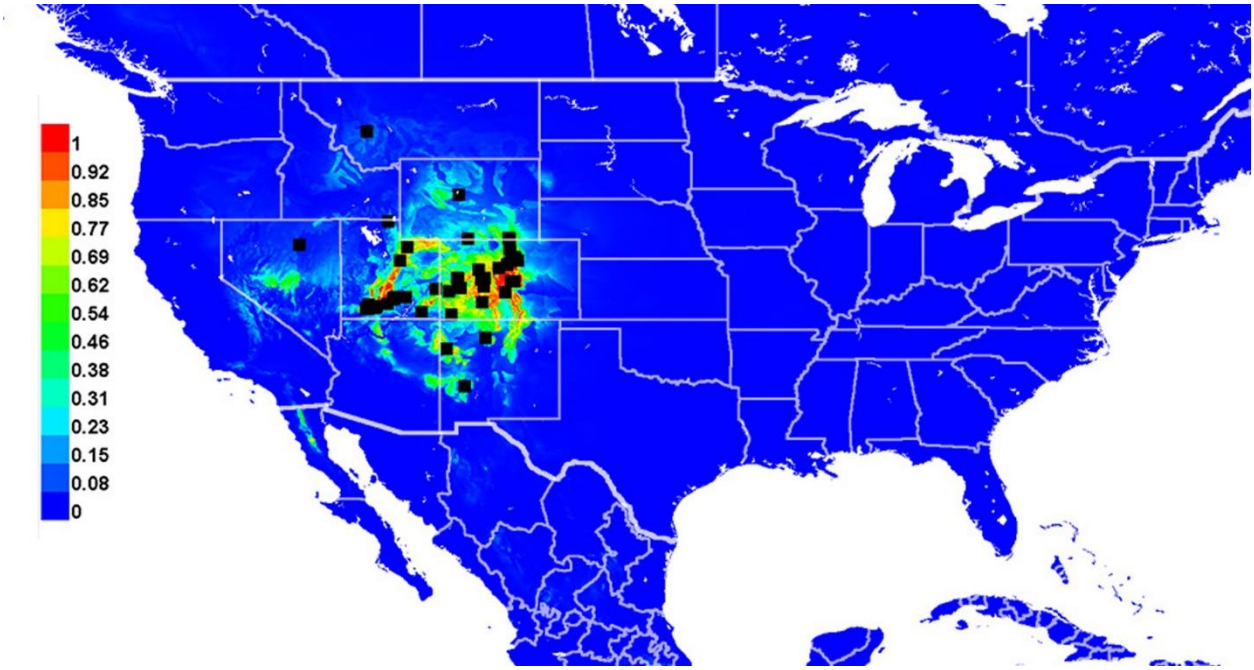


Figure 53. Georeferenced collection records of *Protandrena* (*Pterosarus*) *didirupa* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *dracomons* new species**

(Figure 54)

Diagnosis:

Females of *Pr*. (*Pt*.) *dracomons* can be recognized by a combination of their lack of macrosculpture on posterior face of propodeum (contrast all except: *Pr*. *amor*, *Pr*. *albertensis*, *Pr*. *andrenoides*, *Pr*. *barberi*, *Pr*. *bidentis*, *Pr*. *illustris*, *Pr*. *irregularis*, *Pr*. *labrosa*, *Pr*. *perlaevis*, *Pr*. *piercei*), dark pronotal lobes (contrast *Pr*. *amor*, *Pr*. *barberi*, *Pr*. *labrosa*), mesopleuron punctures uniformly sparse (IS = 1 PD), (contrast *Pr*. *albertensis*, *Pr*. *andrenoides*, *Pr*. *bidentis*, *Pr*. *illustris*, *Pr*. *irregularis*, *Pr*. *perlaevis*) and a non-produced prosternum (contrast *Pr*. *piercei*).

Etymology:

The specific epithet *dracomons* is formed from the Latin draco (‘dragon’) and mons (‘mountain’) in reference to the Dragoon Mountains where the specimen was collected.

Material examined:

USA – **Arizona** • 1♀; Cochise, Dragoon Mountains; [31.8833° N, 109.9833° W]; 10 Sep. 1947; Knull D.J., J.N. leg.; OSUC

Description:

Female:

Structure: Body length range 6.7 mm. Head broader than long (HL/HW ratio 0.82). Face below antennae convex. Labral process narrowly trapezoidal, longer than broad, apex truncate. Clypeus without median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.05). Posterior ocelli 0.35 mm apart. Flagellomeres broader than long. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.4 mm. Metapostnotum not extended medially. Tarsi 2–4 conical. Fore tarsi width 0.0625 mm.

Sculpture: Clypeus punctation fine and sparse (IS = 1 PD). Paraocular punctation fine and sparse (IS = 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 1/2 way down antennal socket. Frons punctation fine and dense (IS < 1 PD). Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation very fine, sparse (IS > 3 PD). Scutellum punctation fine and sparse (IS > 1 PD). Mesopleuron punctation fine and sparse (IS = 1 PD). Lateral propodeum punctation fine and dense (IS < 1 PD). Posterior propodeum punctation absent. Posterior propodeum tessellate. Dorsal face of T1

punctation fine and sparse (IS > 1 PD). T2 basal impression shallow, approximately 1/2 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation sparse (IS = 1 PD).

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F3-F9 yellow ventrally. Pronotal lobe black. Tegula brown. Wing veins and stigma brown, membrane hyaline. All tibia dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity long, yellow/brown. Scutellum pilosity long, yellow/brown. Mesopleuron pilosity long, yellow/brown. Sternite pubescence colour yellow/brown. S3 pubescence long, dense. S4 pubescence long, dense. S5 pubescence long, dense.

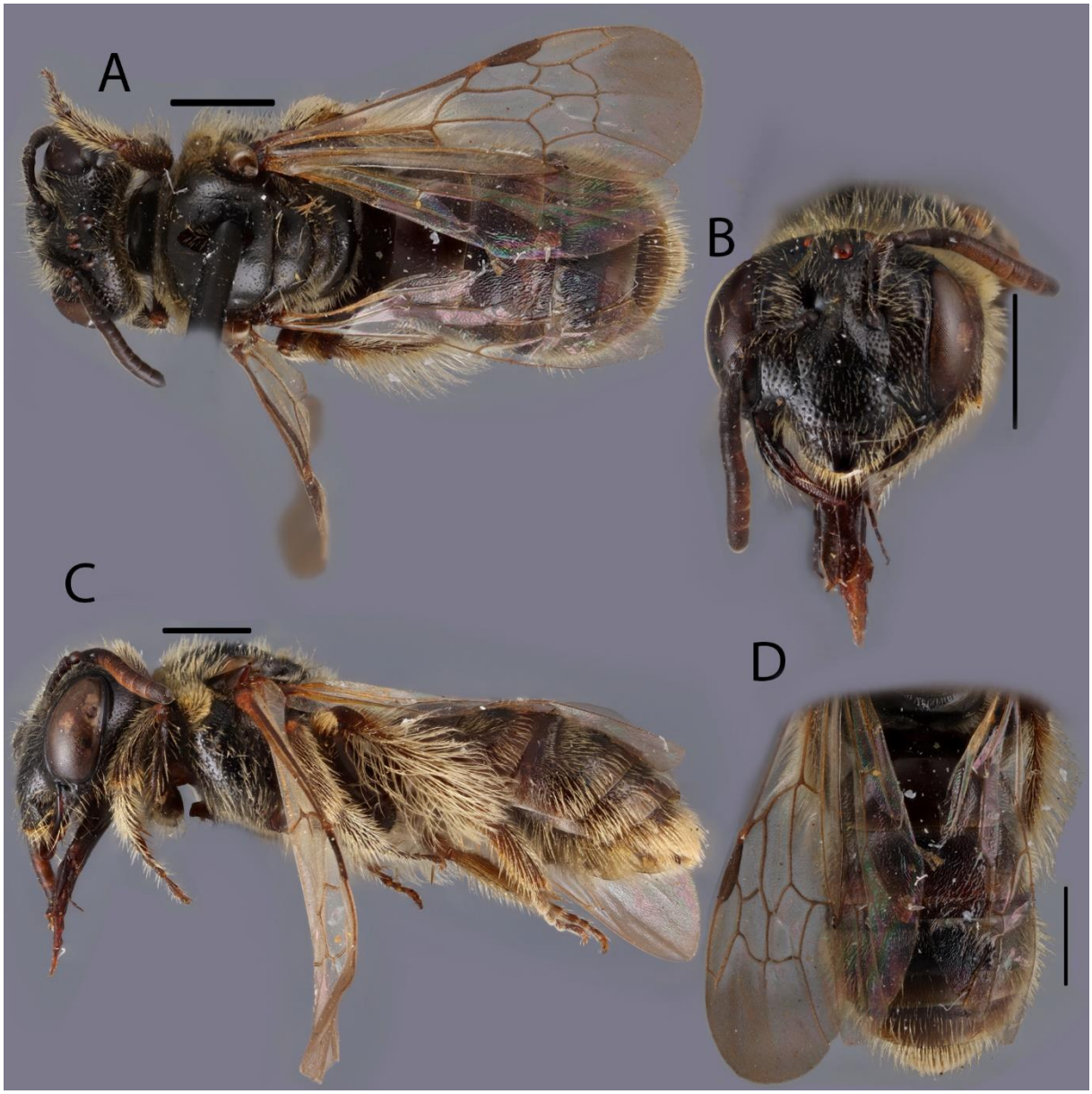


Figure 54. *Protandrena* (*Pterosarus*) *dracomons*, ♀. OSUC_127335. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

***Protandrena* (*Pterosarus*) *ehnesae* new species**

(Figure 55, Figure 56)

Etymology: *Protandrena* (*Pterosarus*) *ehnesae* is named for Mandy Ehnes, a friend and mentor and biology instructor at Algoma University.

Diagnosis:

Males of *Pr*. (*Pt*.) *ehnesae* can be recognized by their flat face (contrast all except: *Pr. boylei*, *Pr. irregularis*, *Pr. piercei*, *Pr. planafacialis*, *Pr. renimaculatus*, and *Pr. rudbeckiae*), face not entirely yellow below antennae (contrast *Pr. boylei*, *Pr. irregularis*, *Pr. piercei*, *Pr. planafacialis*, and *Pr. renimaculatus*), and metapostnotum strongly extended medially >50% way to propodeal pit (contrast *Pr. rudbeckiae*).

Females of *Pr*. (*Pt*.) *ehnesae* can be recognized by their conically projected prosternum (contrast all except: *Pr. lutzae*, *Pr. piercei*, and *Pr. rudbeckiae*) and face flattened below antennae (contrast *Pr. lutzae*, *Pr. piercei*, and *Pr. rudbeckiae*).

Material examined:

– **Maryland** • 1♀, 2♂♂; Anne Arundel; [38.8983° N, 76.669° W]; 20 Sep. 2004; Andrus R. leg.; BIML • 1♀; Charles; [38.6808° N, 77.0944° W]; 30 Sep. 2003; Ibrahim M. leg.; BIML • 3♀♀, 3♂♂; Hartford; [39.4517° N, 76.26° W]; 10 Sep. 2016; Ziolkowski D. leg.; BIML • 1♀; Montgomery; [39.1092° N, 77.1425° W]; 26 Aug. 2017; Droege S.W. leg.; BIML • 4♀♀; Prince Georges; [39.0181° N, 76.8211° W]; 15 Sep. 2017; Seitz N. leg.; BIML • 8♂♂; Somerset; [38.2097° N, 75.8035° W]; 12 Sep. 2016; Droege S.W. leg.; BIML • 1♀; Stevensville; [38.98° N, 76.31° W]; 15 Sep. 2016; Righter A. leg.; BIML

Description:

Male:

Structure: Body length range 6–6.7 mm. Head broader than long (HL/HW ratio 0.88). Face below antennae flat. Labral process trapezoidal, broader than long, apex emarginate. Clypeus with median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.3). Posterior ocelli 0.29 mm apart. Flagellomeres longer than broad. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.2 mm. Metapostnotum strongly extended medially >50% way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.16 mm. S6 notch deep, extending approximately 1/2 of disk, lateral carina absent.

Sculpture: Clypeus punctation coarse and sparse laterally (IS > 1 PD) absent medially. Paraocular punctation fine and sparse (IS > 1 PD). Supraclypeal area punctation fine and sparse (IS = 1 PD). Fovea clavate, converging above, narrow end terminating 1 MOD from dorsal tangent of antennal socket. Frons punctation finely reticulate. Vertex punctation fine and sparse (IS > 1 PD). Mesoscutum punctation finely reticulate anteriorly sparser posteriorly (IS > 1 PD). Scutellum punctation fine and dense (IS < 1 PD). Mesopleuron punctation fine and sparse (IS = 1 PD). Lateral propodeum punctation finely reticulate. Posterior propodeum punctation finely reticulate. Posterior propodeum tessellate. Punctation of dorsal face of T1 mixed very fine and coarse punctures, coarse punctures sparse (IS = 1 PD). T2 basal impression shallow, spproximately 1/2 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus yellow. Supraclypeal area with large roughly triangular yellow mark, terminating in line with paraocular mark. Lower paraocular area yellow 1/2 MOD below dorsal margin of clypeus, and extend diagonally to 1 MOD below antennal socket along compound eye. Labral process yellow. Mandible yellow. Scape black. Flagellomeres dark. Pronotal lobe yellow.

Tegula brown. Wing veins and stigma brown, membrane smoky. Fore tibia yellow anteriorly dark posteriorly, mid and hind tibia yellow apically and basally. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, yellow/brown. Scutellum pilosity medium-length, white. Mesopleuron pilosity medium-length, white. Sternite pubescence colour yellow. S3 pubescence medium-length, sparse. S4 pubescence medium-length, sparse. S5 pubescence medium-length, sparse.

Female:

Structure: Body length range 6.2–7.3 mm. Head broader than long (HL/HW ratio 0.85). Face below antennae flat. Labral process trapezoidal, broader than long, apex truncate. Clypeus without median impressed line. Compound eyes parallel (UOD/LOD ratio 1.05). Posterior ocelli 0.32 mm apart. Flagellomeres broader than long. Dorsal pronotal carina extend laterally to pronotal lobes. Prosternum conically produced. ITD 1.46 mm. Metapostnotum not extended medially. Tarsi 2–4 conical. Fore tarsi width 0.07 mm.

Sculpture: Clypeus punctation fine and sparse (IS = 1 PD). Paraocular punctation fine and sparse (IS = 1 PD). Supraclypeal area punctation fine and sparse (IS = 1 PD). Fovea clavate, converging above, narrow end terminating 1/2 way down antennal socket. Frons punctation fine and dense (IS < 1 PD). Vertex punctation fine and sparse (IS > 1 PD). Mesoscutum punctation very fine, sparse (IS > 3 PD). Scutellum punctation very fine, sparse (IS > 3 PD). Mesopleuron punctation very fine, sparse (IS > 3 PD). Lateral propodeum punctation very fine, dense (IS < 1 PD). Posterior propodeum punctation very fine, sparse (IS > 1 PD). Posterior propodeum tessellate. Punctation of dorsal face of T1 very fine sparse punctures (IS > 5 PD). T2 basal impression

shallow, approximately 1/4 of T2 lineolate basally. T3 punctation dense (IS < 1 PD) laterally, impunctate medially. T4 punctation dense (IS < 1 PD) laterally, impunctate medially.

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres dark. Pronotal lobe black. Tegula brown. Wing veins and stigma brown, membrane hyaline. Fore and mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi dark brown, basitarsis yellow.

Pubescence: Mesoscutum pilosity short, brown. Scutellum pilosity medium-length, brown. Mesopleuron pilosity long, white. Sternite pubescence colour yellow. S3 pubescence medium-length, sparse. S4 pubescence medium-length, sparse. S5 pubescence medium-length, sparse.

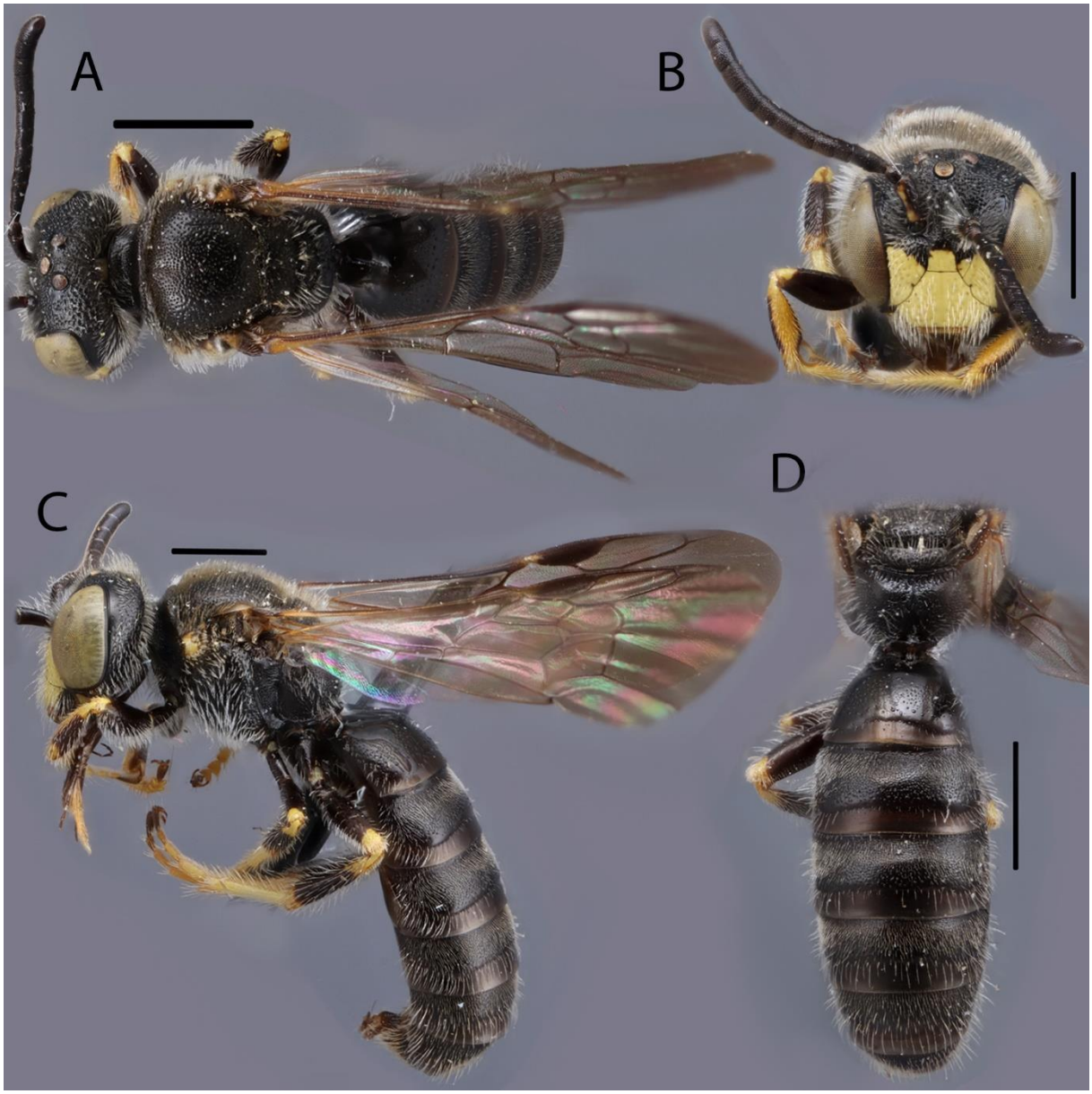


Figure 55. *Protandrena* (*Pterosarus*) *ehnesae*, ♂. USGS-DRO 451032. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

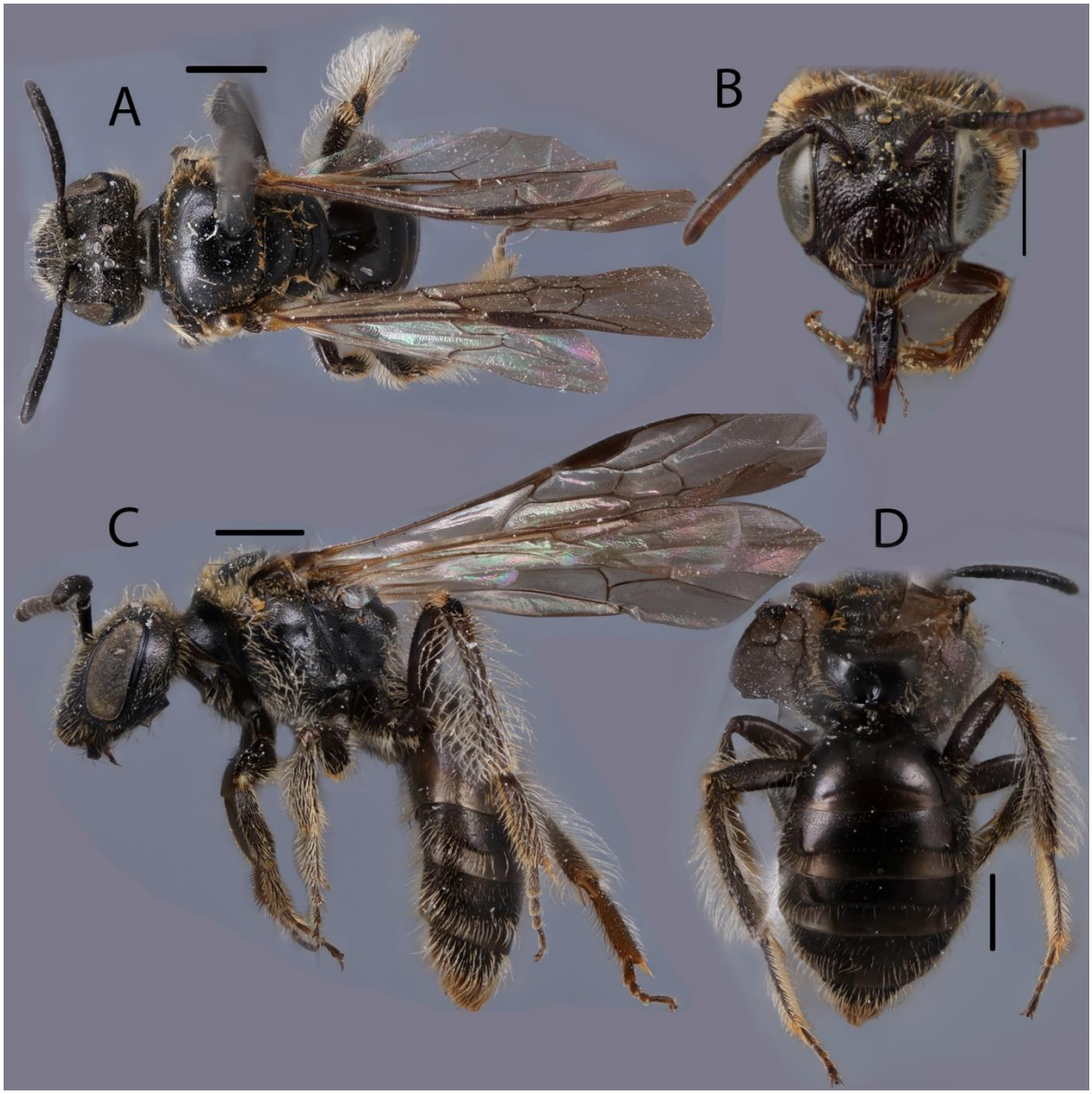


Figure 56. *Protandrena* (*Pterosarus*) *ehnesae*, ♀. USGS-DRO 496094. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Range:

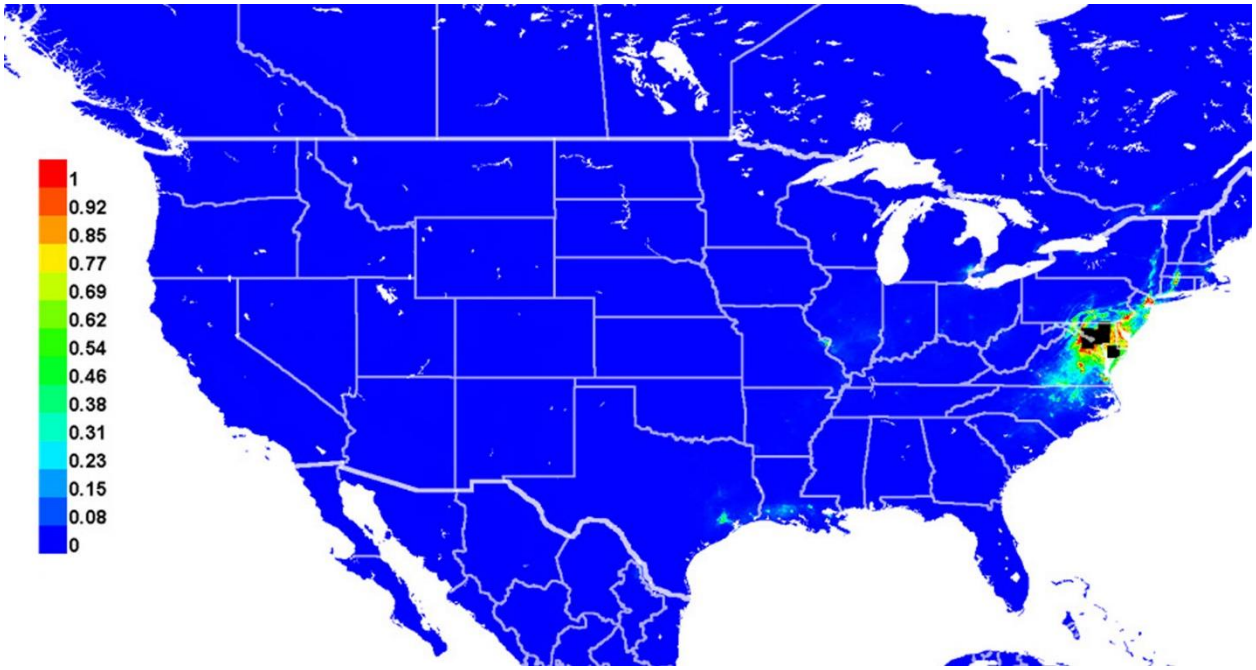


Figure 57. Georeferenced collection records of *Protandrena* (*Pterosarus*) *ehnesae* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *illustris* (Timberlake)**

(Figure 58, Figure 59)

Pseudopanurgus illustris Timberlake, 1967: 18–19. ♀. Holotype ♀ AMNH: 324609. Type locality: USA; Arizona: Southwest Research Station. 12 Sep 1962. 5400 feet. ex. *Viguiera*. Examined specimen.

Type specimens: Timberlake (1967) described *Pseudopanurgus illustris* from four females. The female at the AMNH was selected as the holotype.

Diagnosis:

Males of *Pr.* (*Pt.*) *illustris* can be recognized by a combination of their lack of macrosculpture on posterior face of propodeum (contrast all except: *Pr. bidentis*, *Pr. barberi*, *Pr. irregularis*, *Pr. labrosa*, *Pr. perlaevis*), dark pronotal lobes (contrast *Pr. barberi*, *Pr. labrosa*, *Pr. perlaevis*) and uniformly sparse scutum punctures (IS > 1 PD) (contrast remaining).

Females of *Pr.* (*Pt.*) *illustris* can be recognized by a combination of their lack of macrosculpture on posterior face of propodeum (contrast all except: *Pr. albertensis*, *Pr. amor*, *Pr. andrenoides*, *Pr. barberi*, *Pr. bidentis*, *Pr. dracomons*, *Pr. irregularis*, *Pr. labrosa*, *Pr. perlaevis*, *Pr. piercei*), dark pronotal lobes (contrast *Pr. amor*, *Pr. barberi*, *Pr. labrosa*), and very sparse fine scutum punctures (IS > 6 PD) (contrast remaining).

Material examined:

MEXICO – **Sonora** • 3♀♀, 3♂♂; Agua Prieta (30 km E), Rancho San Bernardino Pollination site 21 pond; 100m east of main gate; [31.3158° N, 109.2686° W]; 19 Sep. 2007; Romero J.A. leg.; ex *Verbesina encelioides*; MCUR • 2♀♀, 2♂♂; Agua Prieta (30 km E), Rancho San Bernardino Pollination site 22 Field 3; [31.3222° N, 109.2778° W]; 15 Sep. 2007; Romero J.A. leg.; ex *Verbesina encelioides*; MCUR • 1♀, 1♂; Agua Prieta (30 km E), Rancho San Bernardino Pollination site 27 horse corral; [31.3256° N, 109.2667° W]; 09 Sep. 2007; Romero J.A. leg.; ex *Helianthus annuus*; MCUR – **Mexico City** • 1♀; [19.3905° N, 99.4238° W]; elev. 2300 m.; 11 Aug. 1928; Lassmanu G. leg.; CUIC

USA – **Arizona** • 1♀; Cochise, Barefoot Lookout, Barefoot-Rustler Junction; 31.9165° N, 109.2737° W; 01 Sep. 2009; Ascher J.S. leg.; AMNH • 1♂; Cochise, Chiricahua Mountains; [31.9034° N, 109.2756° W]; 05 Sep. 1947; Knull D.J., J.N. leg.; OSUC • 1♀; Cochise, Douglas; [31.3445° N, 109.5453° W]; 11 Sep. 1999; Danforth, Magnacca leg.; CUIC • 2♀♀; Cochise,

Douglas (30 km E), San Bernardino National Wildlife Refuge Riparian site 6 transect 4; [31.3375° N, 109.2625° W]; 15 Oct. 2002; Romero J.A. leg.; MCUR • 2♂♂; Cochise, Portal (4 mi. W); [31.9292° N, 109.0746° W]; 26 Aug. 2013; Ascher J.S. leg.; AMNH • 5♀♀; Cochise, Portal, San Simon Road; [31.9137° N, 109.1414° W]; 08 Sep. 1999; Danforth, Magnacca leg.; CUIC • 1♀; Cochise, Portal, Southwest Research Station; [31.884° N, 109.2061° W]; 01 Sep. 2012; Wyman E.S. leg.; AMNH • 1♀; same location as preceding; 12 Sep. 1962; Rozen J.G. leg.; ex *Verbesina encelioides*; AMNH • 1♀; same location as preceding; 10 Sep. 1962; Rozen J.G. leg.; AMNH • 1♀; same location as preceding; 29 Aug. 2009; Ascher J.S. leg.; AMNH • 1♀; Cochise, Rustler State Park; 31.9133° N, 109.2722° W; elev. 2420 m.; 26 Aug. 2000; Brooks R. leg.; SEMC • 1♀; Cochise, Southwest Research Station, Portal (5 mi. W); [31.884° N, 109.2061° W]; elev. 1646 m.; 24 Sep. 1966; Arnaud P.H. leg.; CAS • 1♀; Cochise , Southwest Research Station, Portal (5 mi. W); [31.884° N, 109.2061° W]; elev. 1646 m.; 12 Sep. 1962; Rozen JG leg.; AMNH • 1♂; Coconino, Flagstaff; [35.1981° N, 111.6513° W]; 04 Aug. 1938; Bell E.L. leg.; AMNH • 1♀; Cohise, Chiricahua Mountains, Texas Canyon; [32.0045° N, 110.1392° W]; elev. 1524-1829 m.; 07 Oct. 1927; Kusche J.A. leg.; CAS • 2♀♀; Yavapai, Jerome, Mingus Mountain; [34.6939° N, 112.1277° W]; 31 Aug. 1964; Michener C.D., Michener D.R. leg.; SEMC – **New Mexico** • 1♀; Bernalillo, Sandia Mountains, Kiwanis Meadow; [35.2053° N, 106.4425° W]; 26 Jul. 2018; ex *Campanula rotundifolia*; OSAC: LP • 3♀♀; Catron, Gila Cliff National Monument (0.35 km ENE); 33.2306° N, 108.216° W; elev. 1757 m.; 02 Sep. 2010; Griswold T.L. leg.; ex *Verbesina* enceliodes; BBSL • 1♂; Catron, Mangas, Route 180 (11 mi. SE); 32.7564° N, 108.3735° W; 04 Sep. 2011; Rozen J.G., Wyman E.S. leg.; AMNH • 1♀; Hidalgo, Animas; [31.9497° N, 108.8067° W]; 17 Sep. 1999; Danforth, Magnacca leg.; CUIC • 1♀, 1♂; Hidalgo, Animas (16 mi. S); [31.7279° N, 108.8222° W]; 30

Aug. 2011; Wyman E.S. leg.; AMNH • 1♀; Hidalgo, Animas (20.3 mi. S); 31.6619° N, 108.8378° W; elev. 1479 m.; 24 Sep. 1999; Michener C.D. leg.; ex *Dalea polygonoides*; SEMC • 2♀♀; Lincoln, Carrizozo (8.8 mi ESE); 33.6744° N, 105.945° W; elev. 1770 m.; 29 Sep. 1999; Michener C.D., Brooks R. leg.; ex *Helianthus petiolaris*; SEMC • 1♀; Lincoln, Ruidoso; 33.57° N, 105.6116° W; elev. 2100 m.; 29 Sep. 1999; Michener C.D. Brooks R. leg.; ex *Verbesina encelioides*; SEMC – **Utah** • 1♀; San Juan, Blanding (24 km S); [37.4052° N, 109.491° W]; 30 Aug. 1986; Parker F.D. leg.; BBSL

Description

Male:

Structure: Body length range 5.35–7 mm. Head broader than long (HL/HW ratio 0.95). Face below antennae convex. Labral process triangular, longer than broad, apex emarginate. Clypeus with median impressed line. Compound eyes convergent below (UOD/LOD ratio 1.16). Posterior ocelli 0.28 mm apart. Flagellomeres longer than broad. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.13 mm. Metapostnotum weakly extended medially <25% way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.11 mm. S6 notch shallow only 1/3, lateral carina absent.

Sculpture: Clypeus punctation fine and sparse (IS = 1 PD). Paraocular punctation coarse and dense (IS < 1 PD). Supraclypeal area punctation fine and sparse (IS = 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 0.5 MOD from dorsal tangent of antennal socket. Frons finely reticulate. Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation fine and sparse (IS > 1 PD). Scutellum punctation fine and dense (IS < 1 PD). Mesopleuron punctation coarse and sparse (IS = 1 PD). Lateral propodeum coarsely reticulate.

Posterior propodeum punctation absent. Posterior propodeum tessellate. Dorsal face of T1 punctation fine and sparse (IS = 1 PD). T2 basal impression deep, basal 1/3 of T2 lineolate. T3 punctation sparse (IS = 1 PD). T4 punctation absent.

Colour: Clypeus yellow. Supraclypeal area with reduced yellow spot 1 MOD in diameter. Lower paraocular area yellow reaching clypeus medially and extending along margin of compound eyes terminating in line with ventral tangent of antennal socket. Labral process yellow. Mandible black. Scape black. Flagellomeres F2-F8 yellow ventrally. Pronotal lobe black. Tegula brown. Wing veins and stigma brown, membrane hyaline. Fore tibia yellow anteriorly dark posteriorly, mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, yellow. Scutellum pilosity long, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium length, sparse. S4 pubescence medium length, sparse. S5 pubescence long, medially directed apicolateral fringes.

Female:

Structure: Body length range 6.3–7.52 mm. Head broader than long (HL/HW ratio 0.89). Face below antennae convex. Labral process U shaped, broader than long, apex rounded. Clypeus with median impressed line. Compound eyes parallel (UOD/LOD ratio 1). Posterior ocelli 0.33 mm apart. Flagellomeres longer than broad. Dorsal pronotal carina extends laterally to pronotal lobes. Prosternum not produced. ITD 1.44 mm. Metapostnotum weakly extended medially <25% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.068 mm.

Sculpture: Clypeus punctation coarse and dense (IS ≤ 1 PD). Paraocular punctation coarse and dense medially (IS < 0.5 PD) sparser laterally (IS = 1 – 4 PD). Supraclypeal area punctation

coarse and sparse (IS >1 PD). Fovea clavate. Foveae converging above, narrow end terminating in line with dorsal tangent of antennal socket. Frons punctation coarse and dense (IS < 0.5 PD) contiguous under median ocellus. Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation very fine and sparse (IS > 6 PD). Scutellum punctation minute and sparse (IS > 4 PD) denser medially and anteriorly (IS = 1 PD). Mesopleuron punctation coarse and dense anteriorly and ventrally (IS < 0.5 PD), sparser dorsoposteriorly (IS > 1 PD). Lateral propodeum punctation fine and dense (IS < 1 PD). Posterior propodeum punctation absent. Posterior propodeum not microsculptured. Dorsal face of T1 punctation very minute and sparse (IS > 10 PD). T2 basal impression absent, less than basal 1/3 of T2 lineolate. T3 punctation sparse (IS > 1 PD). T4 punctation sparse (IS = 1 PD).

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F3-F8 orange ventrally. Pronotal lobe black. Tegula light brown. Wing veins and stigma dark brown, membrane smokey. tibia dark, except for small yellow spot on fore tibae at knee. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, yellow/brown. Scutellum pilosity of two forms long and short, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence long, sparse. S4 pubescence long, sparse. S5 pubescence long, medially directed apicolateral fringes.

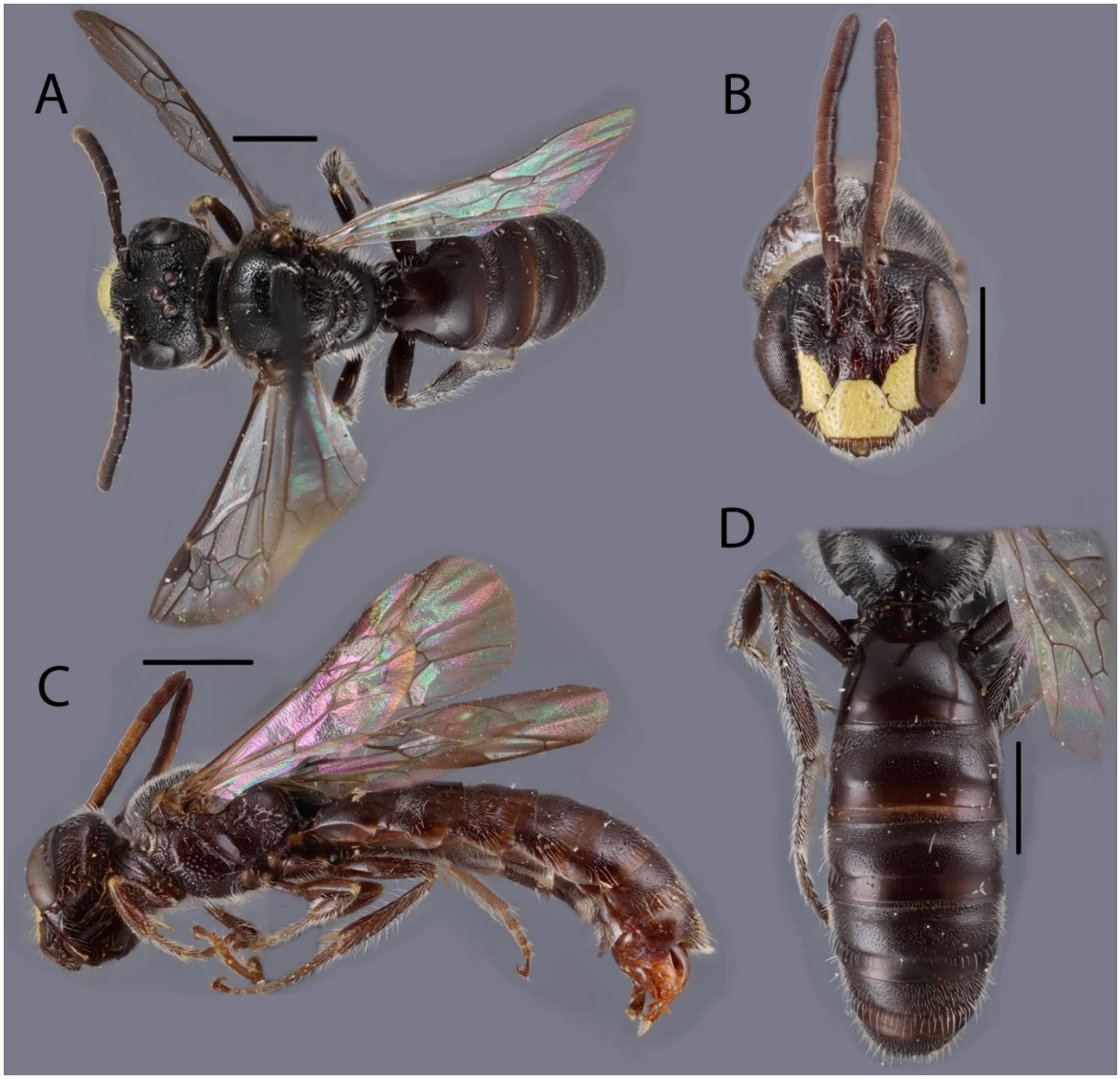


Figure 58. *Protandrena* (*Pterosarus*) *illustris*, ♂. SEMC_287609. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

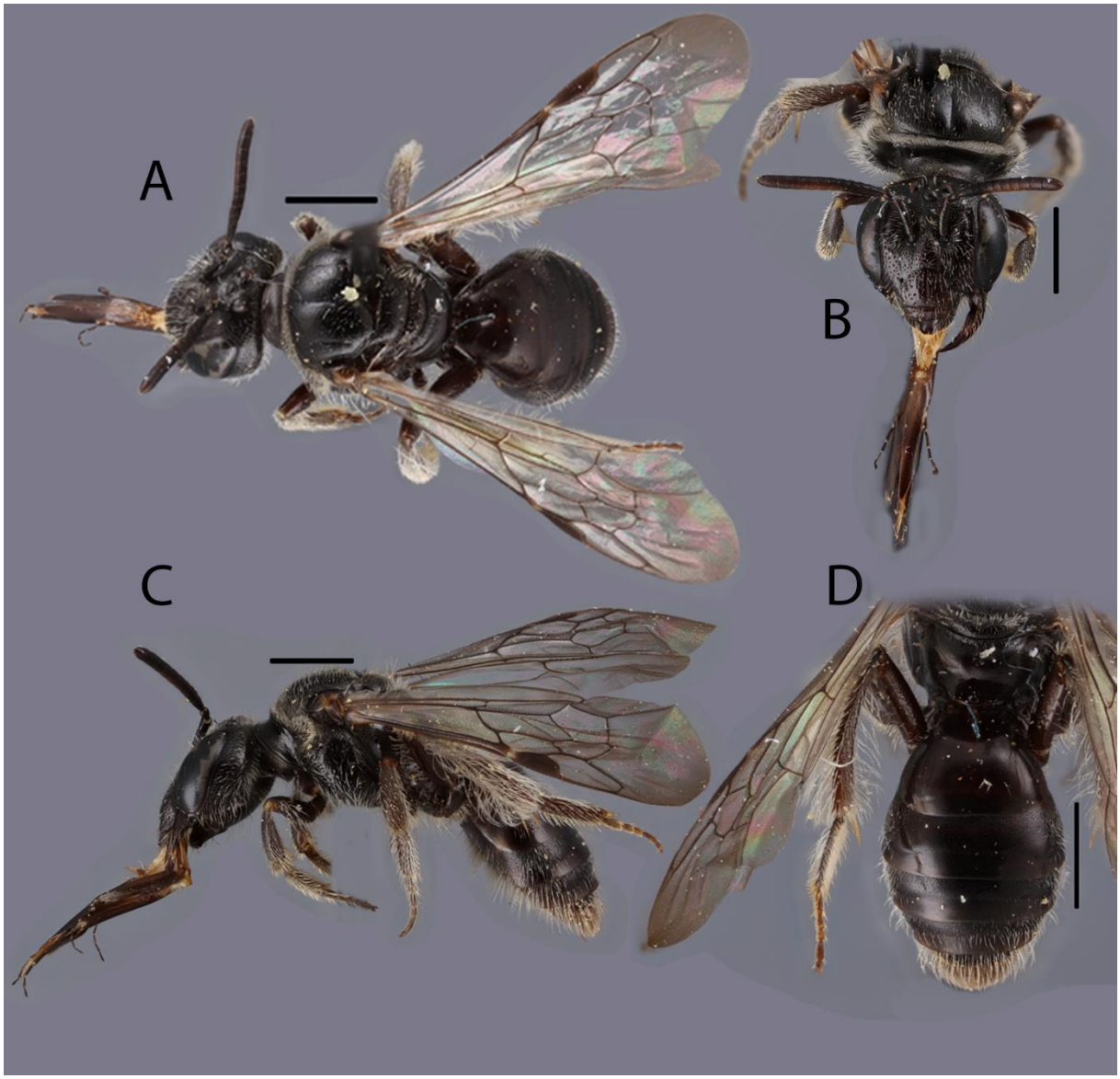


Figure 59. *Protandrena* (*Pterosarus*) *illustris*, ♀. AMNH_00175651. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena illustris* is active from late July to early October. Most floral records for the species come from the tribe Heliantheae, with specific preference for the genus *Verbesina*.

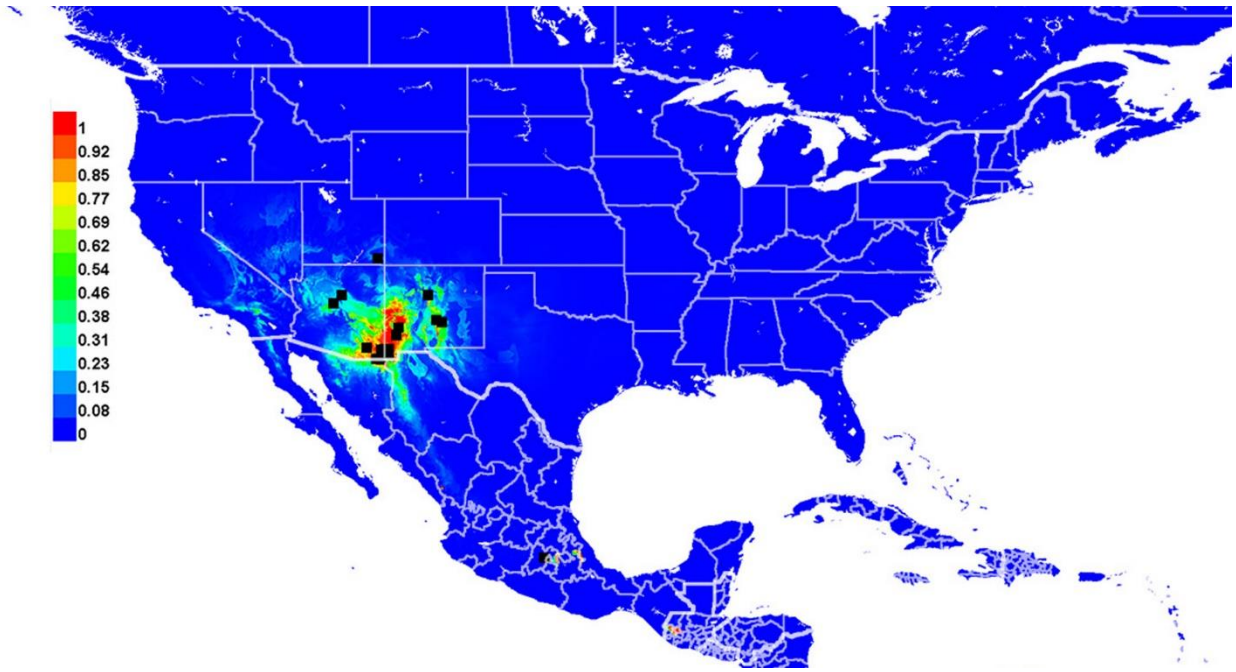


Figure 60. Georeferenced collection records of *Protandrena* (*Pterosarus*) *illustris* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

Range: Mexico (Sonora). USA (Arizona, New Mexico, Utah).

***Protandrena* (*Pterosarus*) *irregularis* (Cockerell)**

(Figure 61, Figure 62)

Panurginus irregularis Cockerell, 1922: 2. Syntype ♂ AMNH: 323871. Type locality: USA; Colorado: Boulder. 12 Aug 1919. 5300 ft. Examined specimen.

Type specimens: Cockerell (1922) described *Panurginus irregularis* from two male specimens. A holotype was not designated. I select specimen 323871 at the AMNH as the lectotype.

Diagnosis:

Males of *Pr*. (*Pt*.) *irregularis* can be recognized by a combination of their non-macrosculptured posterior face of propodeum (contrast all except: *Pr*. *barberi*, *Pr*. *bidentis*, *Pr*. *illustris*, *Pr*. *labrosa*, *Pr*. *perlaevis*), dark pronotal lobes (contrast *Pr*. *barberi*, *Pr*. *labrosa*, *Pr*. *perlaevis*), and face flattened below antennae (contrast remaining).

Females of *Pr*. (*Pt*.) *irregularis* are recognizable by a combination of their lack of macrosculpture on posterior face of propodeum (contrast all except: *Pr*. *albertensis*, *Pr*. *amor*, *Pr*. *andrenoides*, *Pr*. *barberi*, *Pr*. *bidentis*, *Pr*. *dracomons*, *Pr*. *illustris*, *Pr*. *labrosa*, *Pr*. *perlaevis*, *Pr*. *piercei*), dark pronotal lobes (contrast *Pr*. *amor*, *Pr*. *barberi*, *Pr*. *labrosa*), T1 minutely and sparsely punctate (IS > 10 PD), (contrast *Pr*. *albertensis*, *Pr*. *andrenoides*, *Pr*. *bidentis*, *Pr*. *dracomons*, *Pr*. *piercei*) and yellow maculation on face (contrast remaining).

Material examined:

USA – Colorado • 1♂; Boulder; 40° N, 105.25° W; elev. 1676 m.; 07 Aug. 1919; Cockerell T.D.A. leg.; AMNH • 2♂♂; Grand, Granby; [40.0861° N, 105.9395° W]; 05 Aug. 2001; Ascher J.S. leg.; CUIC • 1♂; Rio Grande, Monte Vista NWR; Bunkhouse; 37.4619° N, 106.165° W; elev. 2338 m.; 20 Aug. 2019; Kircus M.B. leg.; ex *Chrysothamnus* sp.; UCMC • 1♂; Teller, Woodland Park (7 mi. N); [39.0639° N, 105.0955° W]; elev. 2438 m.; 02 Jul. 1977; Peck S., Peck J. leg.; PMAE – **Montana** • 1♂; Yellowstone, Pompey's Pillar; [45.9914° N, 107.9521° W]; 09 Aug. 1962; Rozen J.G., Rozen B.L. leg.; AMNH – **New Mexico** • 1♂; Hidalgo, Animas (4 mi. S); [31.901° N, 108.8066° W]; 18 Aug. 1974; Rozen J.G. leg.; AMNH • 1♂; Torrance, Moriarty; [34.9901° N, 106.0492° W]; 26 Aug. 1940; Milliron H.E. leg.; UMSP – **Oregon** • 3♀♀, 2♂♂; Klamath, Modoc Point; [42.4449° N, 121.8683° W]; 14 Aug. 1963; Schuh J. leg.; ex *Grindelia* sp.; AMNH – **Utah** • 2♂♂; Garfield, Middle Bench (1.65 mi. N); [37.5981° N,

111.9436° W]; 02 Aug. 2003; Griswold T.L. leg.; ex *Heliomeris multiflora*; BBSL • 1♂; same location as preceding; 02 Aug. 2003; Johannsen A. leg.; ex Asteraceae sp.; BBSL • 2♂♂; Garfield, Middle Bench (2.09 mi. NW); [37.595° N, 111.9718° W]; 02 Sep. 2003; Johannsen A. leg.; ex *Heterotheca villosa*; BBSL • 5♂♂; same location as preceding; 02 Sep. 2003; Griswold T.L. leg.; ex *Heterotheca villosa*; BBSL • 2♂♂; Garfield, Middle Bench (2.86 mi. NNW); [37.611° N, 111.9662° W]; 22 Aug. 2003; Highbee S. leg.; ex *Grindelia squarrosa*; BBSL • 1♂; same location as preceding; 22 Aug. 2003; Highbee S. leg.; ex *Heterotheca* sp.; BBSL • 1♂; same location as preceding; 22 Aug. 2003; Ikerd H. leg.; ex *Gutierrezia sarothrae*; BBSL • 1♂; same location as preceding; 22 Aug. 2003; Ikerd H. leg.; ex *Grindelia squarrosa*; BBSL – **Wyoming** • 1♂; Albany, Laramie; [41.3114° N, 105.5911° W]; 03 Jul. 1956; Fronk W.D. leg.; ESUW • 1♂; Platte, Chugwater; [41.7566° N, 104.8216° W]; 04 Aug. 1951; Pfadt R.E. leg.; ESUW

Description

Male:

Structure: Body length range 4.68–5.52 mm. Head broader than long (HL/HW ratio 0.91). Face below antennae flat. Labral process trapezoidal, broader than long, apex truncate. Clypeus with median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.31). Posterior ocelli 0.30 mm apart. Flagellomeres longer than broad. Dorsal pronotal carina extends laterally to pronotal lobes. Prosternum not produced. ITD 0.93 mm. Metapostnotum extended medially 25%–50% way to propodeal pit by almost 1/2 its normal width. Tarsi 2–4 triangular. Fore tarsi width 0.12 mm. S6 notch deep extending well over 1/2 of disk, lateral carina absent.

Sculpture: Clypeus punctation fine and dense (IS < 1 PD). Paraocular punctation finer and sparser medially (IS = 1-2 PD), coarser and denser laterally (IS = 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea clavate. Foveae converging above, narrow end terminating to a fine point in line with dorsal tangent of antennal socket. Frons punctation reticulate. Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation fine and dense on anterior and posterior borders (IS = 1 PD) sparser on middle of disk (IS = 1 – 2 PD. Scutellum punctation coarse and sparse (IS > 2 PD) denser medially and anteriorly (IS < 0.5 PD). Mesopleuron punctation coarse and dense anteriorly and ventrally (IS < 0.5 PD), sparser dorsoposteriorly (IS > 1 PD). Lateral propodeum punctation reticulate. Posterior propodeum punctation absent. Posterior propodeum tessellate. Dorsal face of T1 punctation coarse and dense (IS < 1 PD). T2 basal impression deep, approximately basal 1/2 of T2 subrugosely punctured. T3 punctation dense (IS < 1 PD). T4 punctation sparse (IS = 1 PD).

Colour: Clypeus yellow. Supraclypeal area yellow to just below antennal socket. Lower paraocular area yellow to within 1 MOD below antennal socket, extending to dorsal tangent of antennal socket along compound eye. Labral process yellow. Mandible yellow. Scape yellow anteriorly. Flagellomeres F1-F10 orange ventrally. Pronotal lobe black. Tegula light brown. Wing veins and stigma dark brown, membrane smokey. Fore tibia entirely yellow anteriorly, hind and mid tibia yellow anteriorly but with dark spot in middle. Tarsi yellow.

Pubescence: Mesoscutum pilosity medium-length, yellow/brown. Scutellum pilosity of two forms long and medium-length, yellow/brown. Mesopleuron pilosity mixed long and medium-length, yellow/brown. Sternite pubescence colour white. S3 pubescence medium length, dense.

S4 pubescence medium length, dense. S5 pubescence long, medially directed apicolateral fringes.

Female:

Structure: Body length range 5.73–6.9 mm. Head broader than long (HL/HW ratio 0.85). Face below antennae convex. Labral process broadly u shaped, longer than broad, apex rounded. Clypeus without median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.04). Posterior ocelli 0.34 mm apart. Flagellomeres broader than long. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.23 mm. Metapostnotum weakly extended medially <25% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.0625 mm.

Sculpture: Clypeus punctation fine and dense (IS < 1 PD). Paraocular punctation fine and dense (IS < 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 1/2 way down antennal socket. Frons finely reticulate. Vertex punctation fine and dense (IS < 1 PD). Mesoscutum punctation fine and dense anteriorly (IS < 1 PD) sparser posteriorly (IS > 4 PD). Scutellum punctation fine and dense (IS < 1 PD). Mesopleuron punctation fine and dense posteriorly (IS < 1 PD), finely reticulate anteriorly. Lateral propodeum finely reticulate. Posterior propodeum punctation absent. Posterior propodeum tessellate. Dorsal face of T1 punctation very minute and sparse (IS > 10 PD). T2 basal impression shallow, approximately 1/4 of T2 lineolate basally. T3 punctation absent. T4 punctation absent.

Colour: Clypeus with reduced yellow spot. Supraclypeal area with quadrate yellow spot that merges with yellow spot. Lower paraocular area black. Labral process black. Mandible black.

Scape black. Flagellomeres F2-F10 yellow ventrally. Pronotal lobe black. Tegula yellow. Wing veins and stigma brown, membrane light brown. Fore and mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, yellow/brown. Scutellum pilosity long, yellow/brown. Mesopleuron pilosity long, yellow/brown. Sternite pubescence colour white. S3 pubescence medium length, sparse. S4 pubescence medium length, sparse. S5 pubescence medium length, sparse.

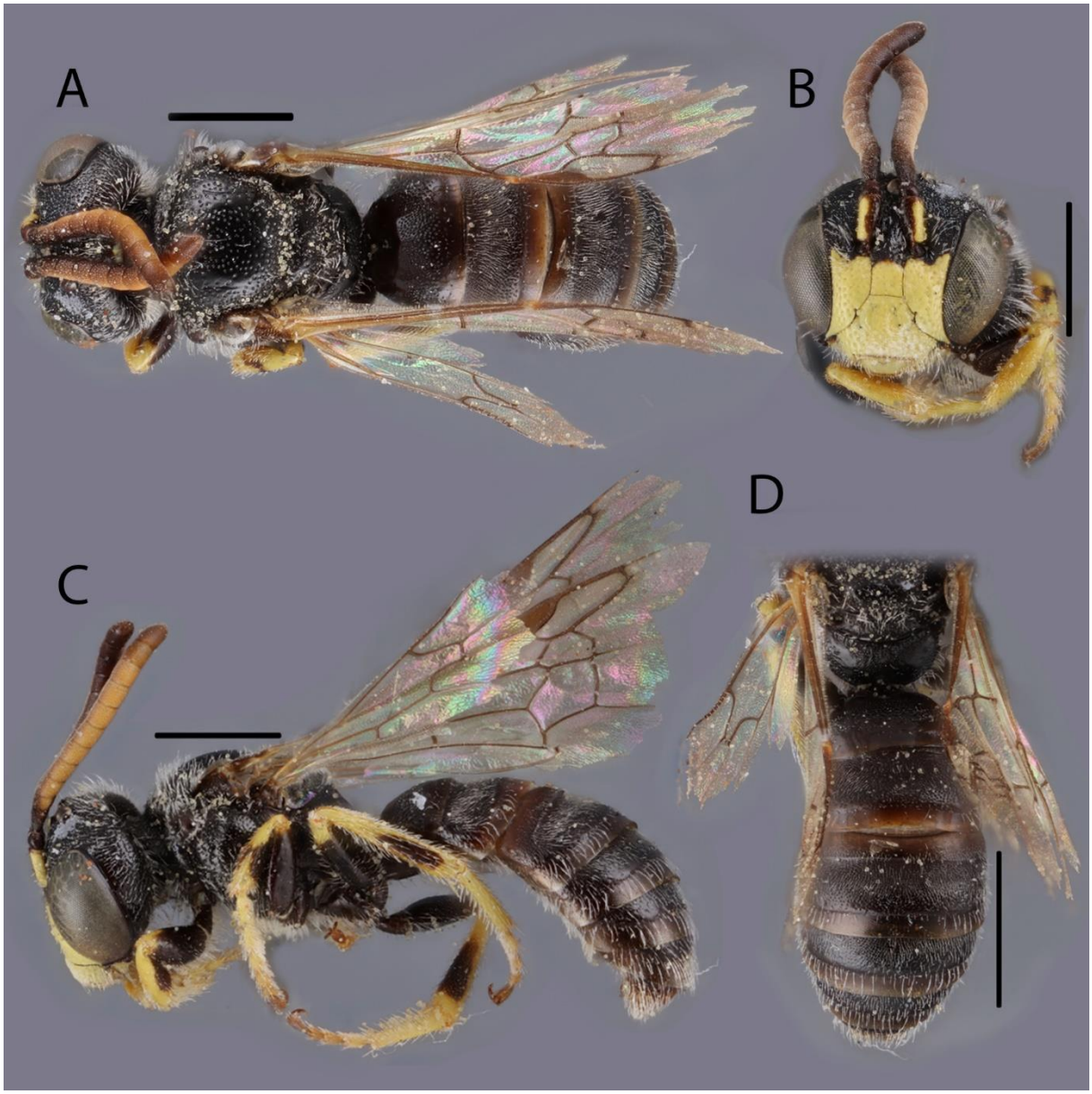


Figure 61. *Protandrena* (*Pterosarus*) *irregularis*, ♂. BBSL_514404. A. Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

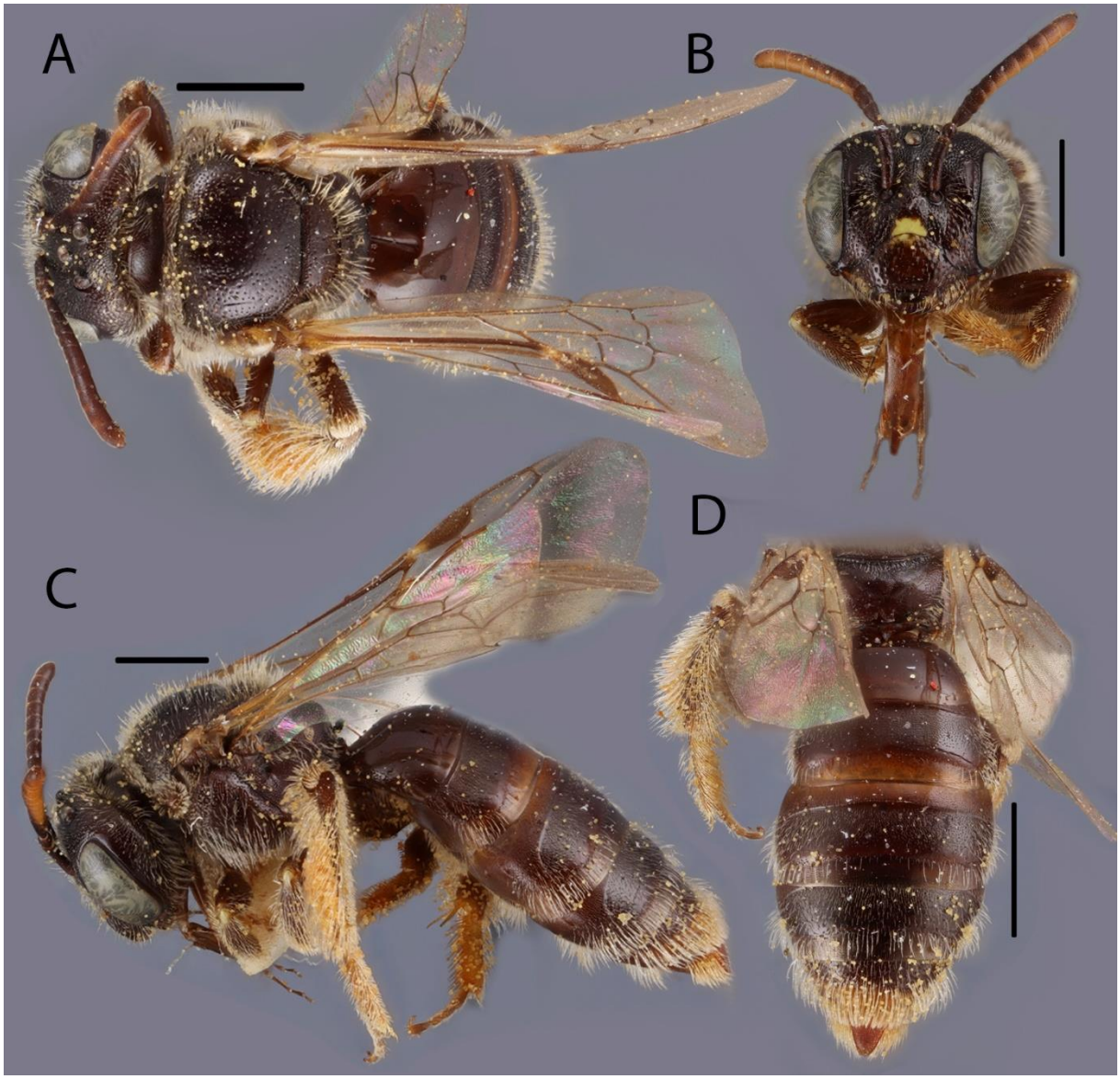


Figure 62. *Protandrena* (*Pterosarus*) *irregularis*, ♀. AMNH_163674. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena irregularis* is active from early July to early September. Most floral records for the species are from males, which seem to show a preference for the tribe Astereae. There are only three floral records for females, all of which are from the genus *Grindelia*.

Range: USA (Colorado, Montana, New Mexico, Oregon, Utah, Wyoming).

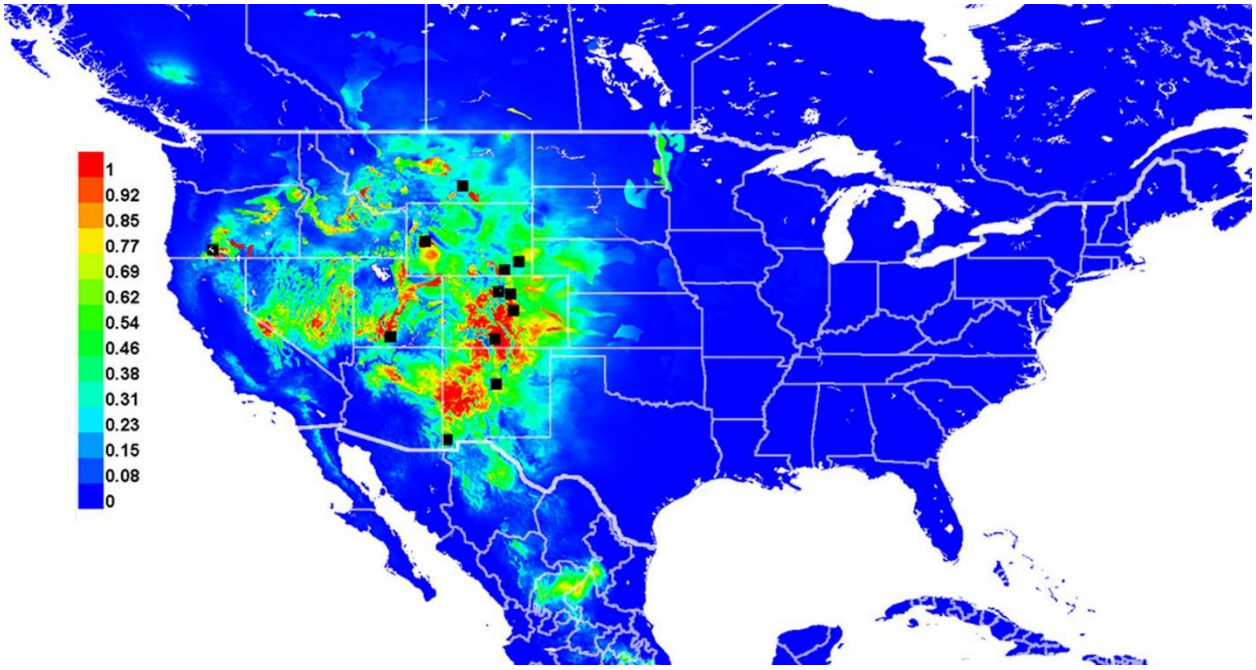


Figure 63. Georeferenced collection records of *Protandrena* (*Pterosarus*) *irregularis* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *labrosa* (Robertson)**

(Figure 64, Figure 65)

Calliopsis labrosus Robertson, 1895: 122. ♀♂. Lectotype ♀ INHS: 15264 Lectotype designation by W. E. LaBerge in Webb (1980). Type locality: USA; Illinois: Macoupin Co., Carlinville (Robertson 1928). Examined specimen.

Taxonomy: Robertson, 1898: 48, ♀♂. —Mitchell, 1960: 268–269 (redescription).

Type specimens: Robertson (1895) described the male and female of *Calliopsis labrosus* from seven females and two males but did not designate a holotype. Some of the syntype series were

later included in the description of *Pr. labrosiformis* (Robertson 1898) . W.E. LaBerge in Webb (1980) designated a female specimen at the INHS as the lectotype of *Pr. labrosa*.

Diagnosis:

Males of *Pr.* (*Pt.*) *labrosa* can be recognized by a combination of their non-macrosculptured posterior face of propodeum (contrast all except: *Pr. barberi*, *Pr. bidentis*, *Pr. illustris*, *Pr. irregularis*, *Pr. perlaevis*), yellow pronotal lobes (contrast *Pr. bidentis*, *Pr. illustris*, *Pr. irregularis*), and dark scape but yellow flagella (remaining).

Females of *Pr.* (*Pt.*) *labrosa* can be recognized by their non-macrosculptured posterior face of propodeum (contrast all except: *Pr. amor*, *Pr. albertensis*, *Pr. andrenoides*, *Pr. barberi*, *Pr. bidentis*, *Pr. dracomons*, *Pr. illustris*, *Pr. irregularis*, *Pr. perlaevis*, *Pr. piercei*), yellow pronotal lobes (contrast *Pr. albertensis*, *Pr. andrenoides*, *Pr. bidentis*, *Pr. dracomons*, *Pr. illustris*, *Pr. irregularis*, *Pr. perlaevis*, *Pr. piercei*) and no visible microsculpture on posterior face of propodeum (contrast remaining).

Material examined:

USA – **Connecticut** • 2♀♀, 1♂♂; Fairfield, New Canaan; [41.1468° N, 73.4948° W]; 22 Sep. 1967; Favreau M. leg.; AMNH – **Georgia** • 1♂; Clarke, Whitehall Forest; [33.8859° N, 83.3563° W]; Aug. 2018; Fortuin C. leg.; UGCA • 1♂; same location as preceding; Aug. 2017; Fortuin C. leg.; UGCA – **Illinois** • 5♂♂; Champaign, Salt Fork River Forest Preserve, Homer (3 mi. N); [40.0602° N, 87.9834° W]; 12 Aug. 1983; Miliczky E. leg.; INHS • 12♀♀, 10♂♂; Macoupin, Carlinville; [39.2798° N, 89.8818° W]; Robertson C. leg.; INHS • 3♀♀; same location as preceding; 19 Aug. 1970; Marlin J.C. leg.; ex *Rudbeckia triloba*; INHS • 1♀; same

location as preceding; 28 Aug.; Robertson C. leg.; INHS • 1♂; same location as preceding; 30 Aug.; Robertson C. leg.; INHS • 1♂; same location as preceding; 01 Aug.; Robertson C. leg.; INHS • 1♀; same location as preceding; 03 Aug.; Robertson C. leg.; INHS • 1♀; same location as preceding; 19 Aug. 1970; Marlin J.C. leg.; ex *Rudbeckia triloba*; INHS • 1♀; same location as preceding; 1898; Robertson C. leg.; INHS • 1♀, 1♂; Vermilion, Muncie at Salt Fork; 40.1132° N, 87.8328° W; 01 Sep. 1912; INHS • 1♀; Washington, DuBois; 38.2517° N, 89.2114° W; 09 Aug. 1917; INHS – **Indiana** • 1♀; Monroe, Morgan-Monroe State Forest; [39.2998° N, 86.3935° W]; 31 Aug. 2018; Jean J. leg.; RJPC • 2♀♀; Putnam, DePauw University; [39.64° N, 86.86° W]; 12 Aug. 1977; Johnson M.D. leg.; ex *Rudbeckia* sp.; RJPC – **Kansas** • 1♂; Douglas; [38.9108° N, 95.2684° W]; 25 Aug. 1949; Michener C.D., Beamer leg.; ex *Silphium perfoliatum*; SEMC • 1♂; Russell, Wilson Lake; [38.9354° N, 98.638° W]; 24 Aug. 1989; Eickwort G.C. leg.; CUIC – **Michigan** • 1♂; Lenawee, Lenawee, Ives Road Fen Preserve; 41.954° N, 83.946° W; 18 Jul. 2018; Wood T.J. leg.; WRME • 1♂; St. Clair, Algonac State Park; [42.65° N, 82.531° W]; 02 Sep. 2017; Wood T.J. leg.; WRME – **Minnesota** • 1♀; Carver, Zumbra Heights; [44.8862° N, 93.6605° W]; 31 Aug. 1929; Alfonsus E.C. leg.; UMSP • 1♂; Chisago, Taylors Falls; [45.4019° N, 92.6524° W]; 12 Aug. 1925; Kemmerly S. leg.; UMSP • 1♀; Jackson, Miloma; [43.7627° N, 95.3683° W]; 12 Sep. 1912; UMSP • 1♂; Marshall; [48.3474° N, 96.395° W]; 28 Jul. 1910; UMSP • 2♂♂; Ramsey, Stryker Avenue Community Garden; 44.9273° N, 93.0883° W; 07 Aug. 2014; Burington J. leg.; MNDNR – **Mississippi** • 1♂; Oktibbeha, Dorman Lake; [33.338° N, 88.874° W]; 11 Sep. 1981; Brown R.L. leg.; MEM – **Missouri** • 1♀; Jefferson, Victoria Glades Conservation Area, Hillsboro (1.5 mi. SE); [38.2026° N, 90.5495° W]; 19 Aug. 1986; Arduser M. leg.; ex *Rudbeckia* sp.; MAPC • 2♀♀, 2♂♂; Laclede, Lebanon; [37.6806° N, 92.6638° W]; 20 Aug. 1953; Michener C.D. leg.; SEMC • 1♀; St. Louis, Tyson

Research Station; [38.526° N, 90.5618° W]; 15 Sep. 1985; Arduser M. leg.; ex *Eupatorium rugosum*; MAPC • 1♀; St. Louis; [38.5885° N, 90.3512° W]; 03 Sep. 2020; Fogel N. leg.; WRME • 1♂; St. Louis; [38.6419° N, 90.3176° W]; 14 Aug. 2020; Fogel N. leg.; WRME – **North Dakota** • 1♀; Cass, Fargo; [46.8772° N, 96.7898° W]; 19 Aug. 1923; Stevens O.A. leg.; ex *Rudbeckia laciniata*; AMNH – **Ohio** • 1♀; Ashland, Greenwich; [41.027° N, 82.4038° W]; 19 Aug. 2020; Heath White leg.; OSUC: KG • 1♀; Clermont, Goshen; [39.2423° N, 84.1931° W]; 23 Sep. 2020; Gunn C. leg.; OSUC: KG • 1♂; Highland; [39.2229° N, 83.507° W]; 09 Aug. 1926; Kennedy C.H. leg.; OSUC • 4♀♀; Medina, Seville; [41.0162° N, 81.9401° W]; 30 Aug. 2020; Stitt B. leg.; OSUC: KG • 1♂; Ross; [39.3295° N, 83.0595° W]; Aug. 1927; Kennedy C.H. leg.; OSUC • 1♀; Washington, Elk Run; [39.500057° N, 81.2486° W]; 12 Sep. 2021; Laura Hughes leg.; ex *Verbesina* alternifolia; OSUC: KG • 1♀; Washington, Wingett Run; [39.538137° N, 81.2387° W]; 03 Sep. 2021; Laura Hughes leg.; ex *Helianthus* sp.; OSUC: KG • 1♀; Wayne, Wooster; [40.8108° N, 82.0196° W]; 21 Sep. 2020; Boyer P. leg.; OSUC: KG • 1♀; Sycamore Creek Park; [39.8804° N, 82.7458° W]; 29 Aug. 2019; Spring M. leg.; OSUC: KG • 1♀, 2♂♂; Wolf Run State Park; [39.7906° N, 81.5486° W]; 14 Aug. 2019; Spring M. leg.; OSUC: KG – **Virginia** • 1♀; Pulaski, Radford Army Ammunition Plant; [37.18° N, 80.54° W]; 11 Aug. 2016; Orcutt E. DiIoia L. leg.; BIML – **West Virginia** • 1♀; Albermale; [38.0909° N, 78.4934° W]; 17 Sep. 2003; Smith D. leg.; BIML • 1♀; Hampshire; [39.322° N, 78.4302° W]; 15 Aug. 2004; Droege S.W. leg.; BIML • 1♂; Pocahontas; [38.2514° N, 80.039° W]; 10 Aug. 2018; Hepner M.J. leg.; BIML • 1♀; Putnam; [38.5317° N, 81.8054° W]; 28 Aug. 2018; Hepner M.J. leg.; BIML – **Wisconsin** • 1♂; Dane, Madison, Rieder farm; [43.059° N, 89.4818° W]; 22 Aug. 1983; Sammataro D. leg.; WIRC • 1♀; Douglas, Gordon (3 mi N), along Highway 53; [46.2887° N, 91.8115° W]; 09 Aug. 1986; Arduser M. leg.; ex *Helianthus maximilianus*; MAPC • 1♀;

Grant, Bush Clover Prairie, T5N R3W Sec 17; [42.908° N, 90.7536° W]; 20 Aug. 1996; Williams A.H. leg.; ex *Helianthus occidentalis*; WIRC • 1♀; Grant, Thomas Wet Prairie, T7N R1W Sec 7; [43.101° N, 90.531° W]; 07 Sep. 1997; Williams A.H. leg.; ex *Helianthus grosseserratus*; WIRC

Description

Male:

Structure: Body length range 4.9–5.98 mm. Head broader than long (HL/HW ratio 0.93). Face below antennae convex. Labral process trapezoidal, broader than long, apex emarginate. Clypeus without median impressed line. Compound eyes convergent below (UOD/LOD ratio 1.17). Posterior ocelli 0.28 mm apart. Flagellomeres longer than broad. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.05 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.11 mm. S6 notch deep and U shaped extending 2/3 of disk, lateral carina absent.

Sculpture: Clypeus punctation coarse and sparse (IS = 1 – 2 PD). Paraocular punctation coarse and dense (IS = 0.5 PD). Supraclypeal area punctation fine and sparse medially (IS > 1 PD) denser laterally (IS < 1 PD). Fovea clavate. Foveae strongly convergent above, narrow end terminating 1 MOD from dorsal tangent of antennal socket. Frons punctation fine and dense (IS < 1 PD). Vertex punctation fine and dense (IS < 1 PD). Mesoscutum punctation coarse and dense anteriorly (IS < 0.5 PD) sparser posteriorly (IS < 1 PD). Scutellum punctation coarse and dense (IS < 1 PD). Mesopleuron punctation coarse and sparse (IS > 1 PD) denser dorsally (IS < 1 PD). Lateral propodeum punctation reticulate. Posterior propodeum punctation absent. Posterior propodeum tessellate. Dorsal face of T1 punctation fine and sparse (IS > 1 PD). T2 basal

impression deep, basal 1/3 of T2 lineolate. T3 punctation sparse (IS > 1 PD). T4 punctation sparse (IS > 1 PD).

Colour: Clypeus yellow. Supraclypeal area with small yellow spot. Lower paraocular area yellow narrowly extending up margin of compound eye terminating approximately 2 puncture widths from the line of the antennal socket. Labral process yellow. Mandible yellow. Scape black. Flagellomeres F2-F9 yellow ventrally. Pronotal lobe yellow. Tegula yellow. Wing veins and stigma dark brown, membrane light brown. Fore and mid tibia yellow anteriorly but dark posteriorly Hind tibia mostly yellow with dark spot on distal portion of tibia taking up approximately 1/4. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, yellow. Scutellum pilosity short, yellow. Mesopleuron pilosity short, white. Sternite pubescence colour white. S3 pubescence short, dense. S4 pubescence medium length, dense, with medially directed apicolateral fringes. S5 pubescence long, medially directed apicolateral fringes.

Female:

Structure: Body length range 5.73–7.05 mm. Head broader than long (HL/HW ratio 0.89). Face below antennae convex. Labral process triangular, longer than broad, apex truncate. Clypeus without median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.05). Posterior ocelli 0.29 mm apart. Flagellomeres about equal in length and width. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.26 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.066 mm.

Sculpture: Clypeus punctation coarse and sparse (IS = 1 – 2 PD). Paraocular punctation fine and sparse (IS = 1 – 4 PD). Supraclypeal area punctation coarse and sparse (IS = 1 PD). Fovea clavate. Foveae converging above, narrow end terminating along midline of antennal socket. Frons punctation reticulate under median ocellus sparser laterally (IS < 1 PD). Vertex punctation dense (IS < 1 PD). Mesoscutum punctation fine and dense anteriorly (IS ≤ 1 PD) sparser posteriorly (IS = 1 – 2 PD). Scutellum punctation fine and sparse (IS 1 – 2 PD) denser medially (IS < 0.5 PD). Mesopleuron punctation fine and sparse (IS = 1 PD) reticulate dorsally. Lateral propodeum punctation reticulate. Posterior propodeum punctation absent. Posterior propodeum not microsculptured. Dorsal face of T1 punctation very minute and sparse (IS > 10 PD). T2 basal impression shallow, basal 1/4 of T2 lineolate. T3 punctation sparse (IS = 1 PD). T4 punctation sparse (IS = 1 PD).

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F4-F9 yellow ventrally. Pronotal lobe yellow. Tegula light brown. Wing veins and stigma brown, membrane light brown. Fore and mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity of two forms long posteriorly, short anteriorly, white. Mesopleuron pilosity short, white. Sternite pubescence colour white. S3 pubescence short, sparse. S4 pubescence short, sparse. S5 pubescence medium length, medially directed apicolateral fringes.

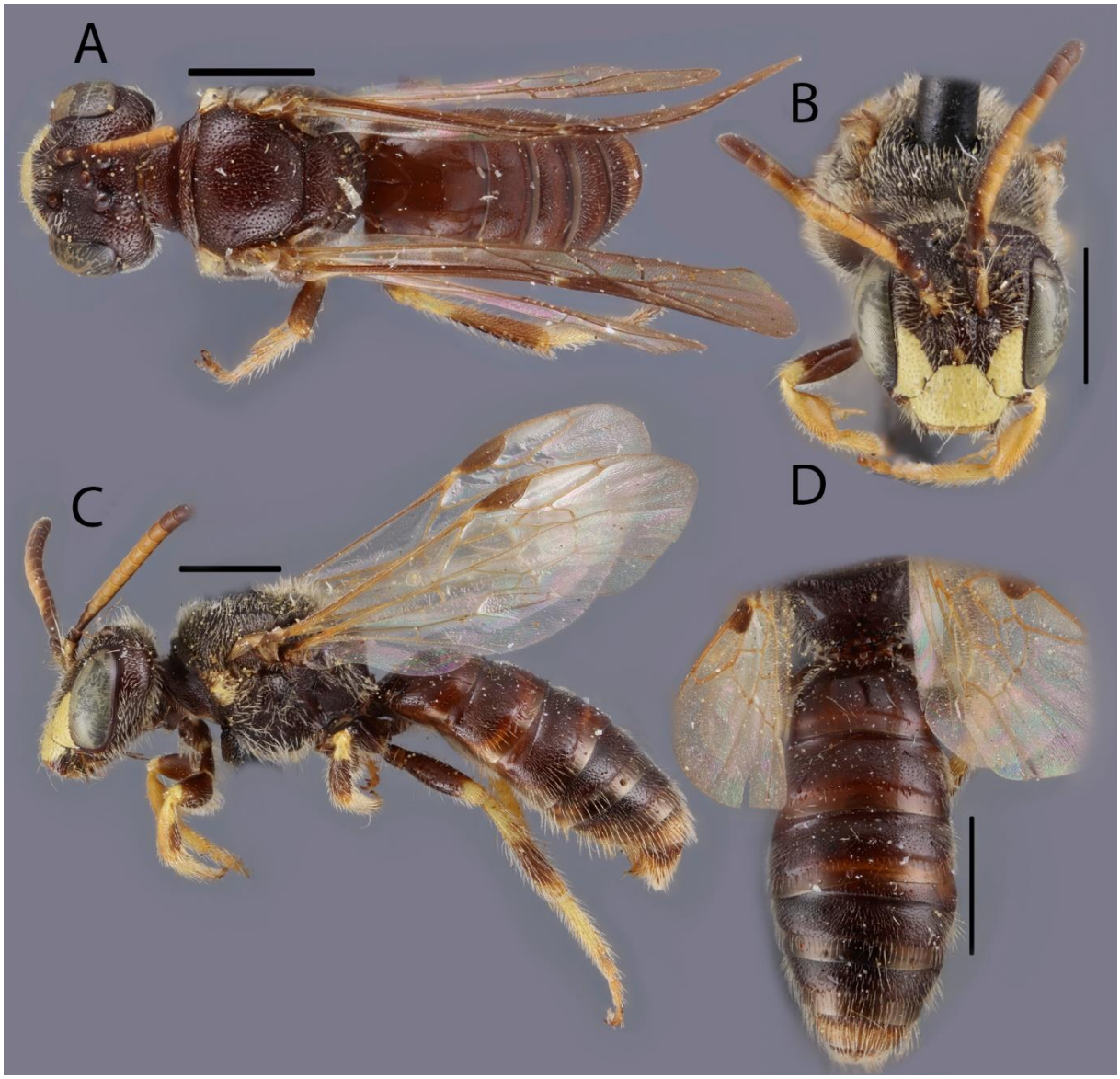


Figure 64. *Protandrena* (*Pterosarus*) *labrosa*, ♂. SEMC_287070. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

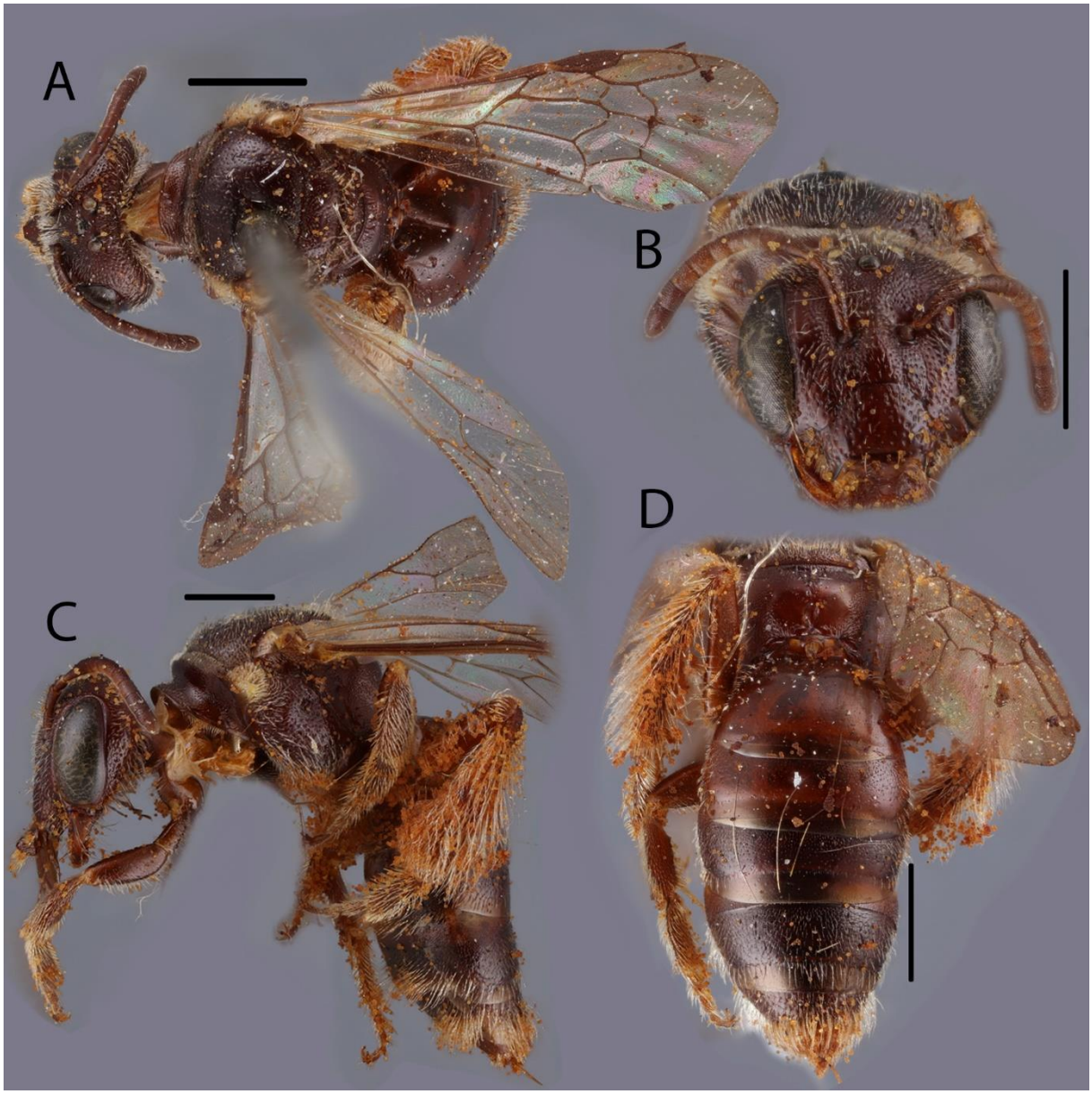


Figure 65. *Protandrena* (*Pterosarus*) *labrosa*, ♀. INHS_299662. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological Notes: *Protandrena labrosa* is active from mid-July to late September. Pierce (1918) recorded *Crawfordia labrosi* (Pierce 1911) as a parasite of *Protandrena labrosa*. Floral records for the species are poor, but seem to show a preference for the tribe Heliantheae.

Range: USA (Connecticut, Georgia, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Mississippi, Missouri, Virginia, West Virginia, Wisconsin).

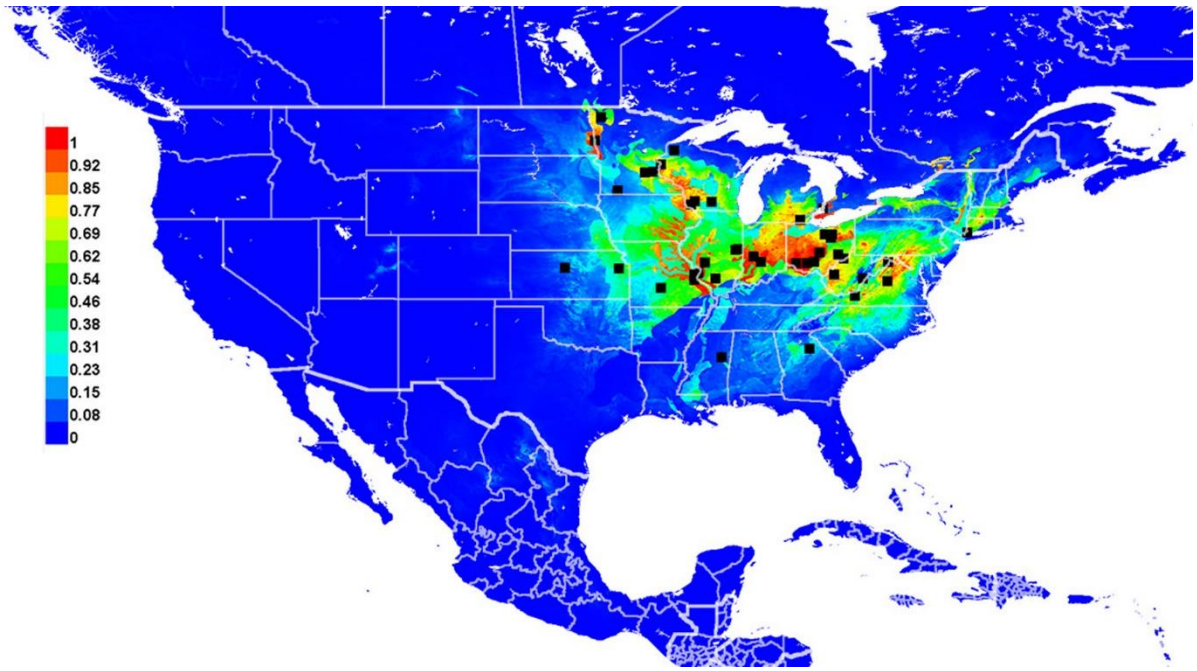


Figure 66. Georeferenced collection records of *Protandrena* (*Pterosarus*) *labrosa* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *labrosiformis* (Robertson)**

(Figure 67, Figure 68)

Panurginus labrosiformis Robertson, 1898: 49. ♀♂. Lectotype ♀ INHS: 15277 designation by W. E. LaBerge in Webb (1980). Type locality: USA; Illinois: Macoupin Co., Carlinville (Robertson 1928). Examined specimen.

Panurginus labrosiformis distractus Cockerell, 1912: 447. ♂. Holotype ♂ CAS: 15416. Type locality: USA; Nebraska: Lincoln. 9 Aug 1912. **New synonymy**. Examined by photos.

Taxonomy: Mitchell, 1960: 274–275 (redescription, key).

Type specimens: Robertson (1898) described *Panurginus labrosiformis* from 15 female and seven male syntypes. W.E. LaBerge in Webb (1980) designated a female specimen at the INHS as the lectotype. Cockerell (1912) described *Panurginus labrosiformis distractus* from a single male specimen, without any comparison to males of the nominal species. The type of *Pa. labrosiformis distractus* has a more constricted labral process but otherwise agrees well with the nominal subspecies. There are too few localities available to fully understand the relationship between this variation and geographical range, so we do not feel separate subspecies deserve recognition.

Diagnosis:

Males of *Pr.* (*Pt.*) *labrosiformis* can be recognized by a combination of their face not entirely yellow below antennae (contrast all except: *Pr. amor*, *Pr. albitarsis*, *Pr. andrenoides*, *Pr. atricornis*, *Pr. barberi*, *Pr. bidentis*, *Pr. californica*, *Pr. citrinifrons*, *Pr. illustris*, *Pr. labrosiformis*, *Pr. labrosa*, *Pr. perlaevis*, *Pr. rudbeckiae*, *Pr. ehnesae*, *Pr. solidaginis*, *Pr. vicina*), yellow pronotal lobes (contrast *Pr. albitarsis*, *Pr. atricornis*, *Pr. bidentis*, *Pr. californica*, *Pr. citrinifrons*, *Pr. illustris*, *Pr. solidaginis*, *Pr. vicina*), posterior face of propodeum reticulate (contrast *Pr. amor*, *Pr. andrenoides*, *Pr. barberi*, *Pr. labrosus*, *Pr. perlaevis*, *Pr. rudbeckiae*), and sparse scutum punctures medially (IS > 1 PD) (contrast *Pr. rudbeckiae*).

Females of *Pr.* (*Pt.*) *labrosiformis* can be recognized by their finely densely punctate posterior face of propodeum (IS < 1 PD) (contrast all except: *Pr. aestivalis*, *Pr. albitarsis*, *Pr. alveus*, *Pr. atricornis*, *Pr. labrosiformis*, *Pr. leucoptera*, *Pr. luxsolaris*, *Pr. nudescens*, *Pr. ornatipes*, *Pr.*

subtilis, *Pr. vigvierae*), scutum punctures dense anteriorly sparse posteriorly (contrast *Pr. albitarsis*, *Pr. alveus*, *Pr. atricornis*, *Pr. labrosiformis*, *Pr. leucoptera*, *Pr. luxsolaris*, *Pr. ornatipes*, *Pr. subtilis*, *Pr. vigvierae*) and triangular labral process (contrast remaining).

Material examined:

USA – **Georgia** • 2♂♂; DeKalb, Stone Mountain; [33.8082° N, 84.1702° W]; 26 Aug. 1945; Fattig P.W. leg.; UGCA • 2♂♂; same location as preceding; 12 Aug. 1932; Fattig P.W. leg.; UGCA • 1♂; same location as preceding; 13 Sep. 1953; Fattig P.W. leg.; UGCA– **Illinois** • 16♀♀, 9♂♂; Macoupin, Carlinville; [39.2798° N, 89.8818° W]; Robertson C. leg.; INHS • 1♂; same location as preceding; 09 Sep.; Robertson C. leg.; INHS • 1♀; same location as preceding; 1898; Robertson C. leg.; INHS • 1♂; Vermilion, Muncie at Salt Fork; 40.1132° N, 87.8327° W; 01 Sep. 1912; INHS – **Missouri** • 1♂; Pettis, Drover's Prairie; [38.532636° N, 93.294232° W]; 11 Sep. 1988; Arduser M. leg.; MAPC • 1♀; same location as preceding; 25 Sep. 1988; Arduser M. leg.; MAPC – **Nebraska** • 1♂; Lancaster, Lincoln; [40.8° N, 96.667° W]; Aug. 1912; Bruner L. leg.; CAS

Description

Male:

Structure: Body length range 4.45–5 mm. Head broader than long (HL/HW ratio 0.96). Face below antennae convex. Labral process trapezoidal, broader than long, apex emarginate. Clypeus with median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.3). Posterior ocelli 0.25 mm apart. Flagellomeres about equal in length and width. Dorsal pronotal carina present. Prosternum not produced. ITD 0.9 mm. Metapostnotum extended medially 25%–

50% way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.098 mm. S6 notch deep extending well over 1/2 of disk, lateral carina absent.

Sculpture: Clypeus punctation coarse and sparse medially (IS = 1 – 2 PD) denser laterally (IS ≤ 0.5 PD). Paraocular punctation coarse and sparse (IS = 1 – 2 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea clavate. Foveae converging above, narrow end terminating well above antennal socket. Frons punctation coarse and dense (IS < 1 PD) reticulate under median ocellus. Vertex punctation reticulate. Mesoscutum punctation coarse and dense anteriorly (IS < 1 PD) sparser posteriorly (IS = 1 PD). Scutellum punctation coarse and sparse (IS > 1 PD) denser medially and anteriorly (IS < 0.5 PD). Mesopleuron punctation coarse and sparse (IS > 1 PD) denser ventrally (IS < 1 PD). Lateral propodeum punctation reticulate. Posterior propodeum punctation reticulate. Posterior propodeum tessellate. Dorsal face of T1 punctation fine and sparse (IS > 1 PD). T2 basal impression deep, approximately 1/2 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation sparse (IS = 1 PD).

Colour: Clypeus yellow. Supraclypeal area with small yellow mark terminating before dorsal margin of paraocular mark. Lower paraocular area yellow narrowly extending along margin of compound eye and terminate approximately 1/2 of the way to the antennal socket. Labral process yellow. Mandible yellow. Scape black. Flagellomeres F1-F9 yellow ventrally. Pronotal lobe yellow. Tegula pale yellow. Wing veins and stigma amber, membrane hyaline. All tibia yellow anteriorly, dark posteriorly. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, yellow. Scutellum pilosity medium-length, yellow/brown. Mesopleuron pilosity short, white. Sternite pubescence colour white. S3

pubescence short, sparse. S4 pubescence medium length, dense. S5 pubescence medium length, medially directed apicolateral fringes.

Female:

Structure: Body length range 5.32–6.23 mm. Head broader than long (HL/HW ratio 0.9). Face below antennae convex. Labral process triangular, broader than long, apex emarginate. Clypeus with median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.05). Posterior ocelli 0.28 mm apart. Flagellomeres broader than long. Dorsal pronotal carina present. Prosternum not produced. ITD 1.12 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.062 mm.

Sculpture: Clypeus punctation coarse and sparse medially (IS > 1 PD) denser posteriolaterally (IS < 1 PD). Paraocular punctation coarse and sparse (IS = 1 – 2 PD). Supraclypeal area punctation coarse and sparse (IS = 2 - 3 PD). Fovea clavate. Foveae converging above, narrow end terminating one third of antennal socket width from dorsal tangent. Frons punctation coarse and dense (IS < 1 PD) reticulate under median ocellus. Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation denser anteriorly (IS < 1 PD) sparser posteriorly (IS = 1 – 2 PD). Scutellum punctation coarse and sparse (IS > 2 PD) denser medially and anteriorly (IS < 0.5 PD). Mesopleuron punctation coarse and dense on borders (IS < 1 PD) sparser medially (IS > 1 PD). Lateral propodeum punctation fine and dense (IS < 1 PD). Posterior propodeum punctation fine and dense (IS < 1 PD). Posterior propodeum tessellate. Dorsal face of T1 punctation fine and sparse (IS > 1 PD). T2 basal impression shallow, less than basal 1/3 of T2 lineolate. T3 punctation sparse (IS = 1 PD). T4 punctation absent.

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F3-F10 yellow ventrally. Pronotal lobe black. Tegula ochreaceous. Wing veins and stigma light brown, membrane hyaline. tibia dark, except for small yellow spot on knee. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity of two forms long and short, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium length, sparse. S4 pubescence medium length, sparse. S5 pubescence long, medially directed apicolateral fringes.

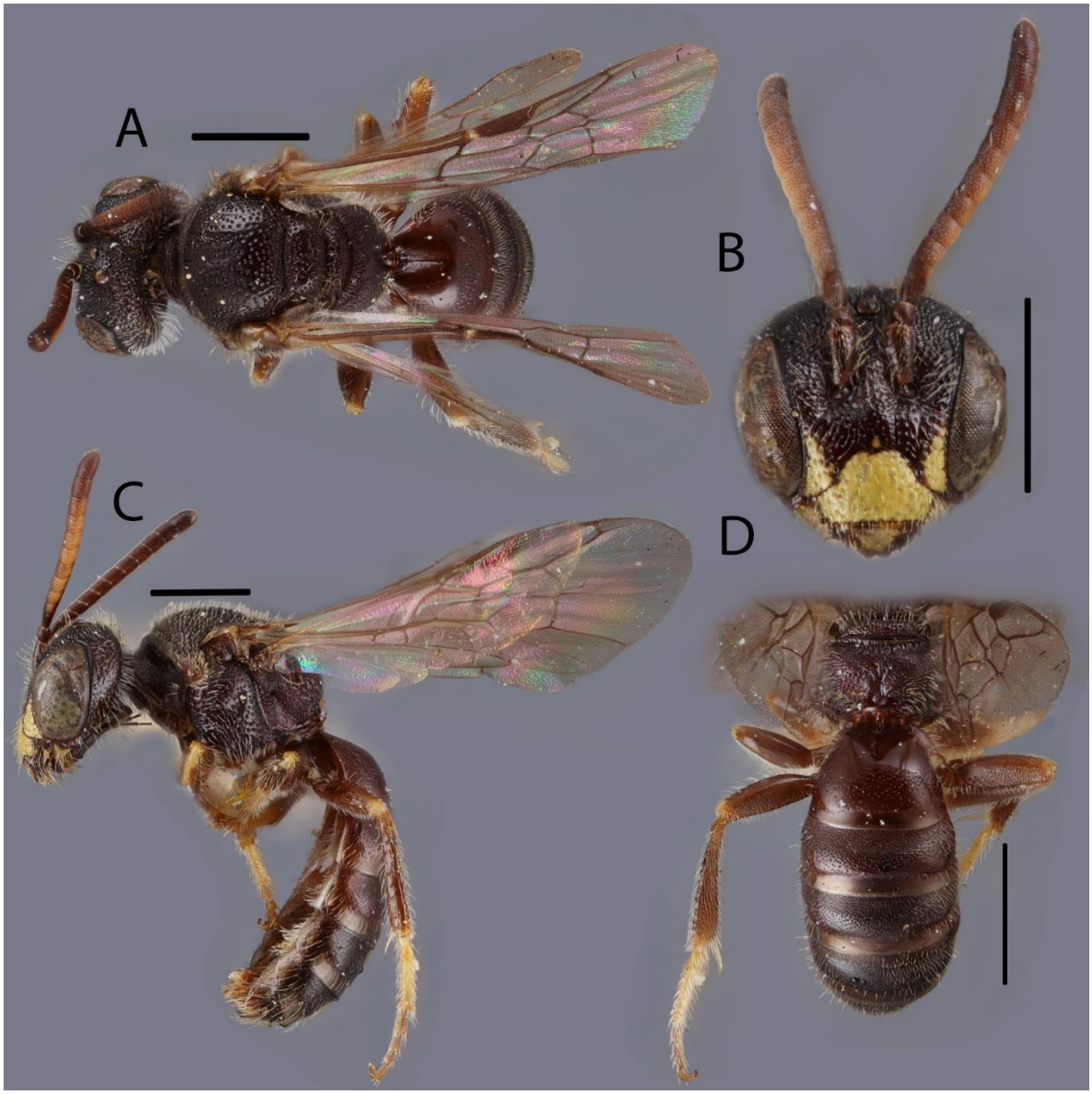


Figure 67. *Protandrena* (*Pterosarus*) *labrosiformis*, ♂. UGCA. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

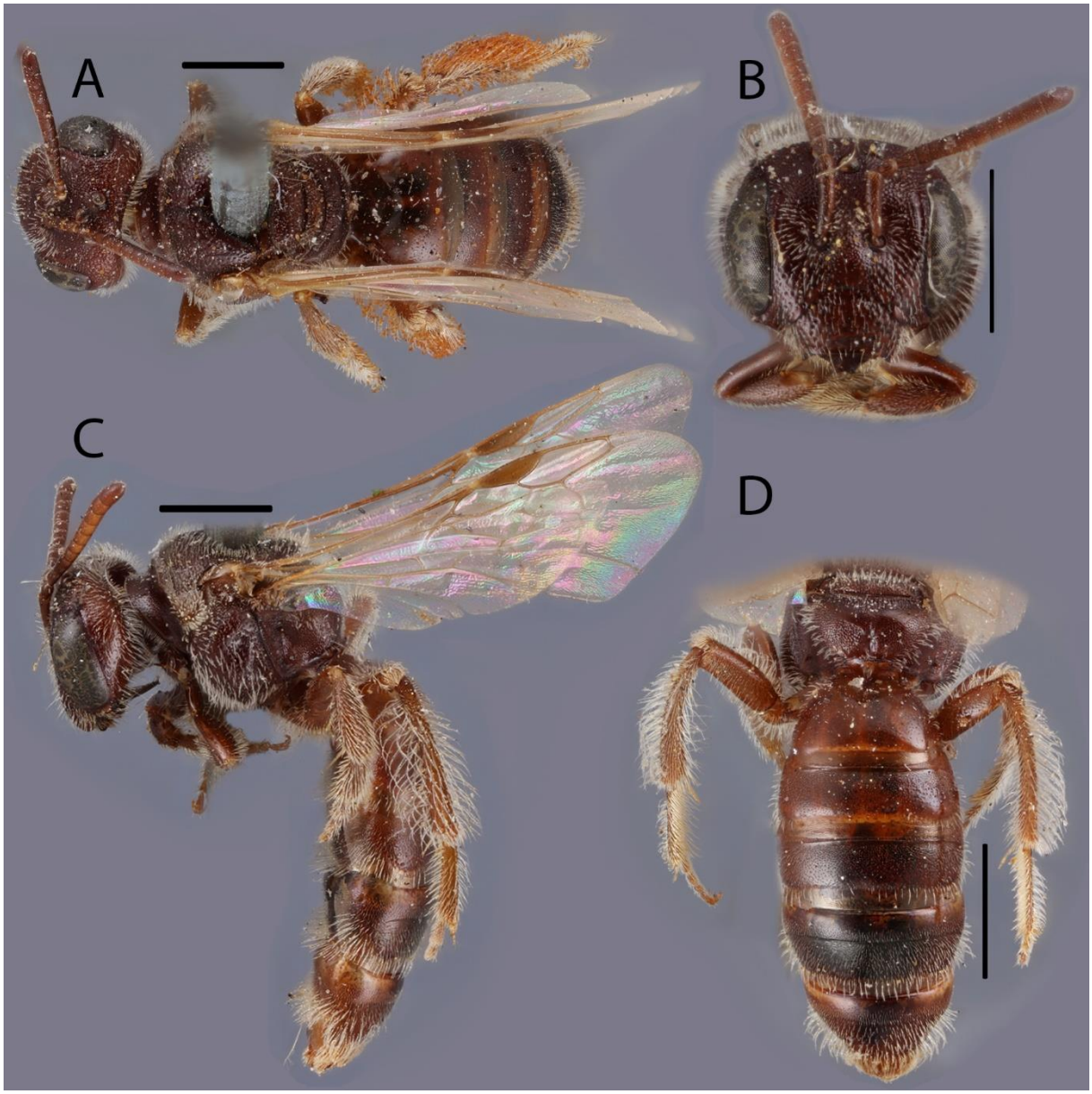


Figure 68. *Protandrena* (*Pterosarus*) *labrosiformis*, ♀. INHS_299623. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena labrosiformis* is active in August and September. Pierce (1918) recorded *Crawfordia labrosiformidis* (Pierce 1918) as the parasite of *Protandrena labrosiformis*. Floral records for the species are poor, but seem to show a preference for the tribe Heliantheae.

Range: USA (Georgia, Illinois, Missouri, Nebraska, [North Carolina]).

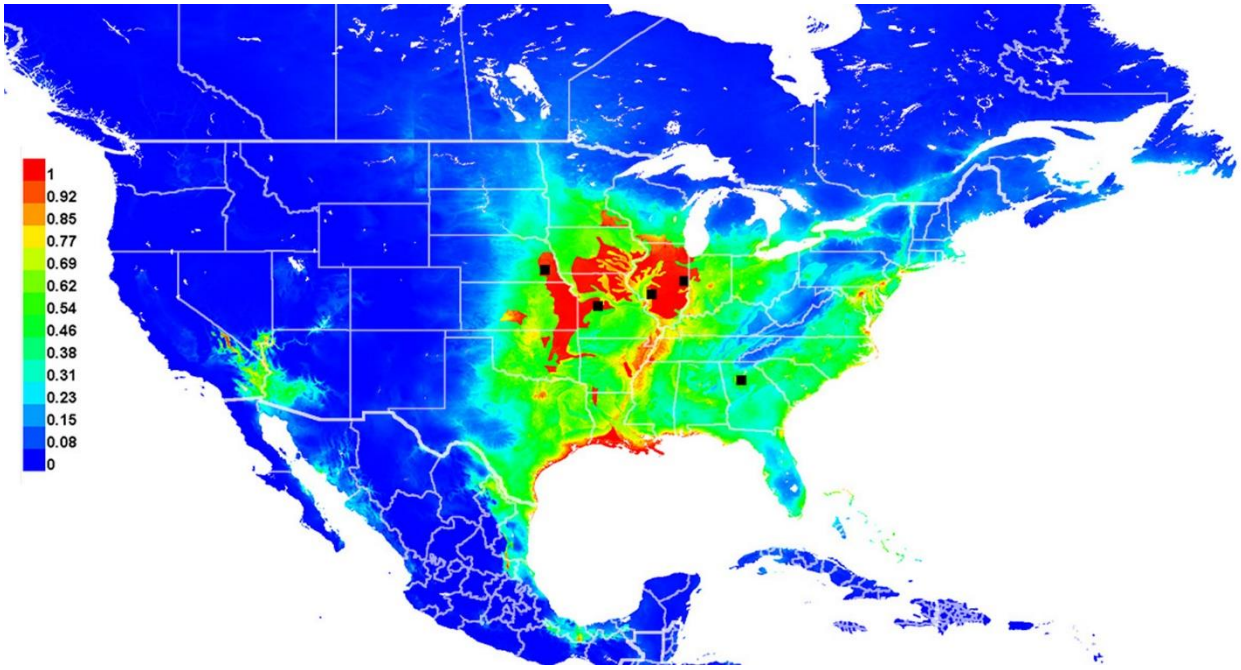


Figure 69. Georeferenced collection records of *Protandrena* (*Pterosarus*) *labrosiformis* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *leucoptera* (Cockerell)**

(Figure 70, Figure 71)

Panurginus leucopterus Cockerell, 1923: 49. ♂. Syntype ♂ NMNH: 533808. Type locality: USA; Colorado: Xenia. 16 Aug 1923. Ex. *Helianthus petiolaris*. Examined by photos.

Type specimens: Cockerell (1923) described the male of *Panurginus leucopterus* from six specimens but did not designate a holotype. I select specimen 533808 at the NMNH as the lectotype.

Diagnosis:

Males of *Pr*. (*Pt*.) *leucoptera* can be recognized by their white maculations on face and white colouration of wings (contrast all other species).

Females of *Pr*. (*Pt*.) *leucoptera* can be recognized by their white wings (contrast all other species).

Material examined:

USA – **Colorado** • 1♂; Morgan, Wiggins (3 mi. NW); [40.265° N, 104.1155° W]; 08 Aug. 1974; Favreau M., Favreau T.M. leg.; AMNH • 1♂; Park, Jefferson, Coal Creek Canyon; [39.3772° N, 105.8006° W]; 16 Aug. 1962; Vogel B. leg.; ex *Helianthus* sp.; UCMC • 1♂; same location as preceding; 16 Aug. 1962; Lanham U.N. leg.; ex *Helianthus* sp.; UCMC • 1♂; Washington, Xenia (7.5 mi. W); [40.1475° N, 103.4863° W]; 16 Aug. 1923; Cockerell T.D.A. leg.; ex *Helianthus petiolaris*; USNM • 2♂♂; Washington, Xenia (7.5 mi. W); [40.1469° N, 103.486° W]; 16 Aug.; Cockerell T.D.A. leg.; ex *Helianthus petiolaris*; AMNH • 1♂; Weld, Central Plains Experimental Range; [40.8413° N, 104.7173° W]; 29 Jul. 1976; Scott J.A. leg.; ESUW • 1♀; Yuma, Newton1; 40.0886° N, 102.4642° W; elev. 1187 m.; 02 Aug. 2014; UCMC – **Nebraska** • 1♂; Sioux, Harrison (7 mi. N); [42.6872° N, 103.8827° W]; 13 Aug. 1962; Rozen J.G., Rozen B.L. leg.; ex *Helianthus* sp.; AMNH – **New Mexico** • 2♀♀; Torrance, Moriarty; [34.9901° N, 106.0492° W]; 26 Aug. 1940; Milliron H.E. leg.; UMSP – **Utah** • 1♂; Emery, Little Gilson Butte, East side of Little Gilson Butte; [38.5923° N, 110.6043° W]; elev. 1585 m.; 26 Aug. 1986; Parker F.D. leg.; BBSL • 1♂; Kane, Cottonwood Creek; [37.0208° N, 112.612° W]; 02 Sep. 2003; Griswold T.L. leg.; ex *Helianthus annuus*; BBSL

Description

Male:

Structure: Body length range 5.17–5.7 mm. Head broader than long (HL/HW ratio 0.94). Face below antennae convex. Labral process trapezoidal, broader than long, apex emarginate. Clypeus with median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.25). Posterior ocelli 0.31 mm apart. Flagellomeres broader than long. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.14 mm. Metapostnotum weakly extended medially <25% way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.1 mm. S6 notch deep extending well over 1/2 of disk, lateral carina absent.

Sculpture: Clypeus punctation fine and dense (IS < 1 PD). Paraocular punctation fine and dense (IS < 1 PD). Supraclypeal area punctation fine and sparse (IS = 1 PD). Fovea clavate. Foveae converging above, narrow end terminating in line with dorsal tangent of antennal socket. Frons finely reticulate. Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation coarse and sparse (IS = 1 PD). Scutellum punctation coarse and dense (IS < 1 PD). Mesopleuron punctation coarse and sparse (IS = 1 PD). Lateral propodeum punctation rugose. Posterior propodeum rugose. Posterior propodeum not microsculptured. Dorsal face of T1 punctation fine and dense (IS < 1 PD). T2 basal impression deep, basal 1/2 of T2 lineolate. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus white. Supraclypeal area white forming a line with paraocular marks. Lower paraocular area white forming a straight line 0.5 MOD from ventral tangent of antennal sockets. Labral process white. Mandible white. Scape black. Flagellomeres F3-F8 yellow ventrally. Pronotal lobe black. Tegula brown. Wing veins pale, stigma brown, membrane white. Fore tibia white anteriorly dark posteriorly, mid and hind tibia with white spot at knee. Tarsi white.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity long, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium length, dense. S4 pubescence medium length, dense. S5 pubescence medium length, medially directed apicolateral fringes.

Female:

Structure: Body length range 6.23–6.58 mm. Head broader than long (HL/HW ratio 0.89). Face below antennae convex. Labral process trapezoidal, broader than long, apex emarginate. Clypeus without median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.01). Posterior ocelli 0.38 mm apart. Flagellomeres broader than long. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.3 mm. Metapostnotum weakly extended medially <25% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.067 mm.

Sculpture: Clypeus punctation fine and sparse (IS = 1 PD). Paraocular punctation fine and dense (IS < 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea clavate. Foveae converging above, narrow end terminating in line with dorsal tangent of antennal socket. Frons finely reticulate. Vertex punctation fine and dense (IS < 1 PD). Mesoscutum punctation fine and sparse (IS > 6 PD). Scutellum punctation fine and dense laterally (IS < 1 PD) finely reticulate medially. Mesopleuron punctation fine and sparse (IS = 1 PD). Lateral propodeum finely reticulate. Posterior propodeum punctation fine and dense (IS < 1 PD). Posterior propodeum not microsculptured. Dorsal face of T1 punctation fine and sparse (IS > 1 PD). T2 basal impression shallow, basal 1/2 of T2 lineolate. T3 punctation sparse (IS > 1 PD). T4 punctation sparse (IS > 1 PD).

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F4-F10 yellow ventrally. Pronotal lobe black. Tegula brown. Wing veins pale, stigma brown, membrane white. All tibia dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity long, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium length, sparse. S4 pubescence medium length, sparse. S5 pubescence medium length, medially directed apicolateral fringes.

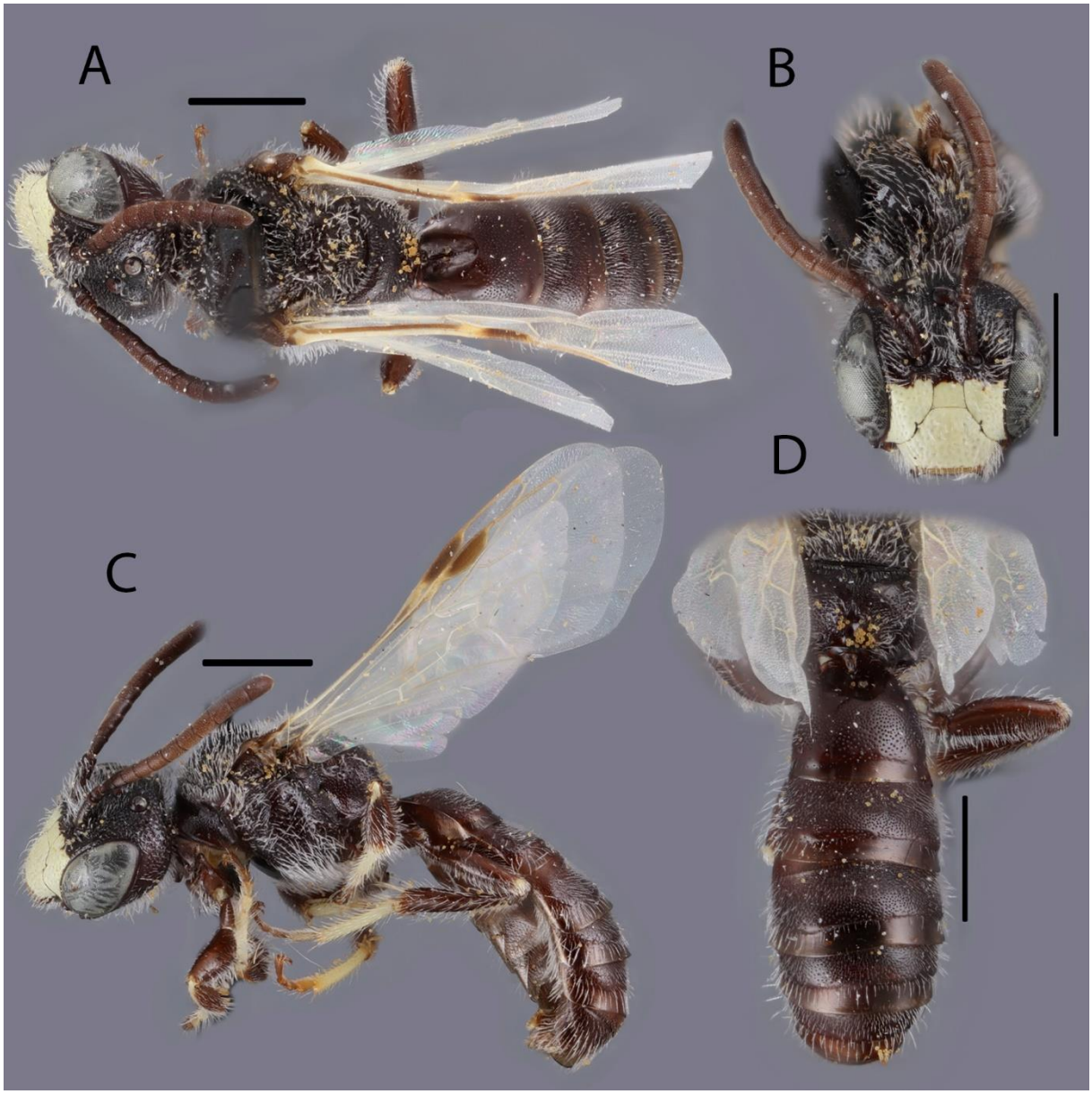


Figure 70. *Protandrena* (*Pterosarus*) *leucoptera*, ♂. UCMC_221261. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

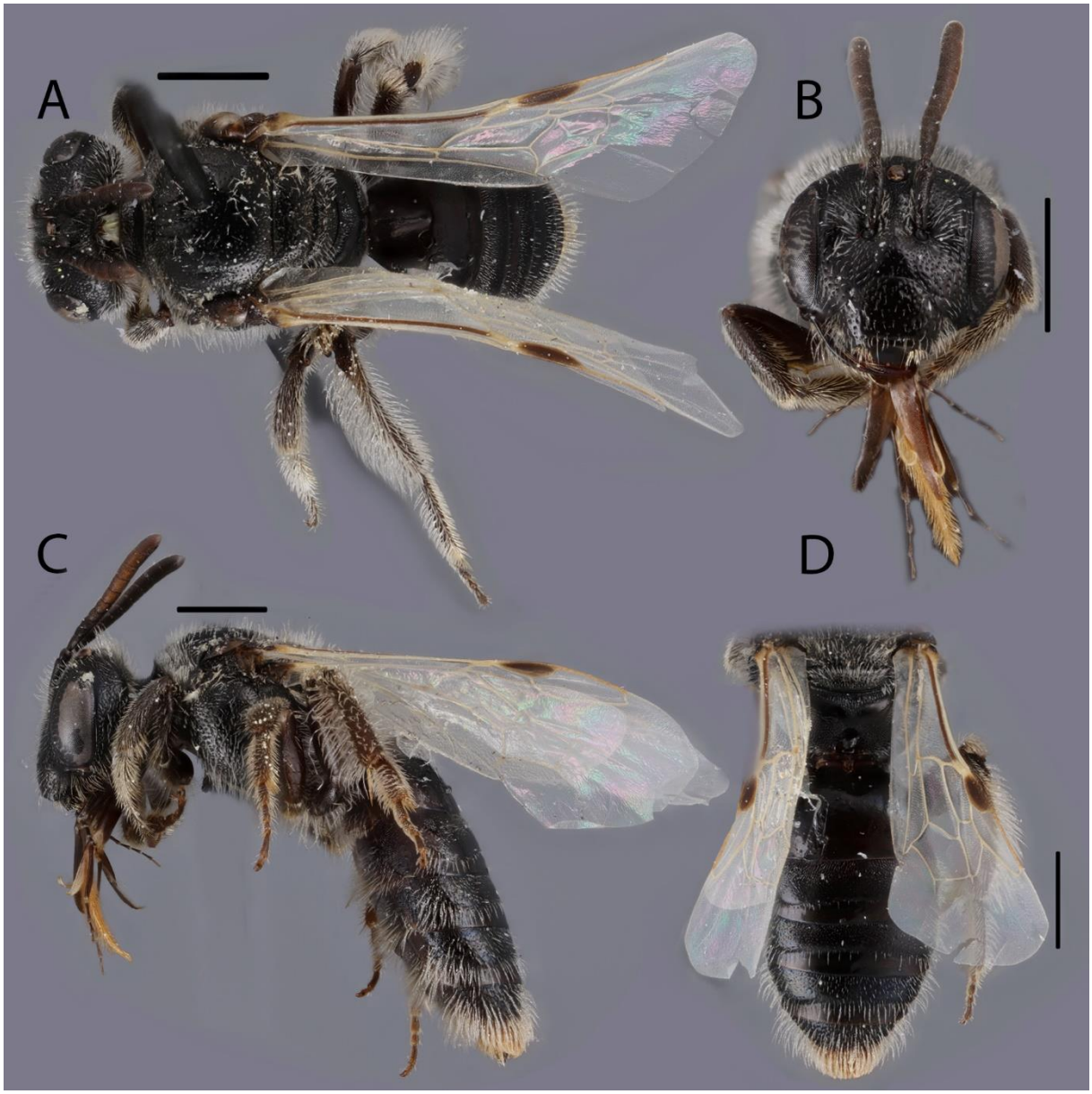


Figure 71. *Protandrena* (*Pterosarus*) *leucoptera*, ♀. UCMC_193148. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena leucoptera* is active from early July to early September. Floral records for the species are known only from males, all of which are from the genus *Helianthus*.

Range: USA (Colorado, Nebraska, New Mexico, Utah).

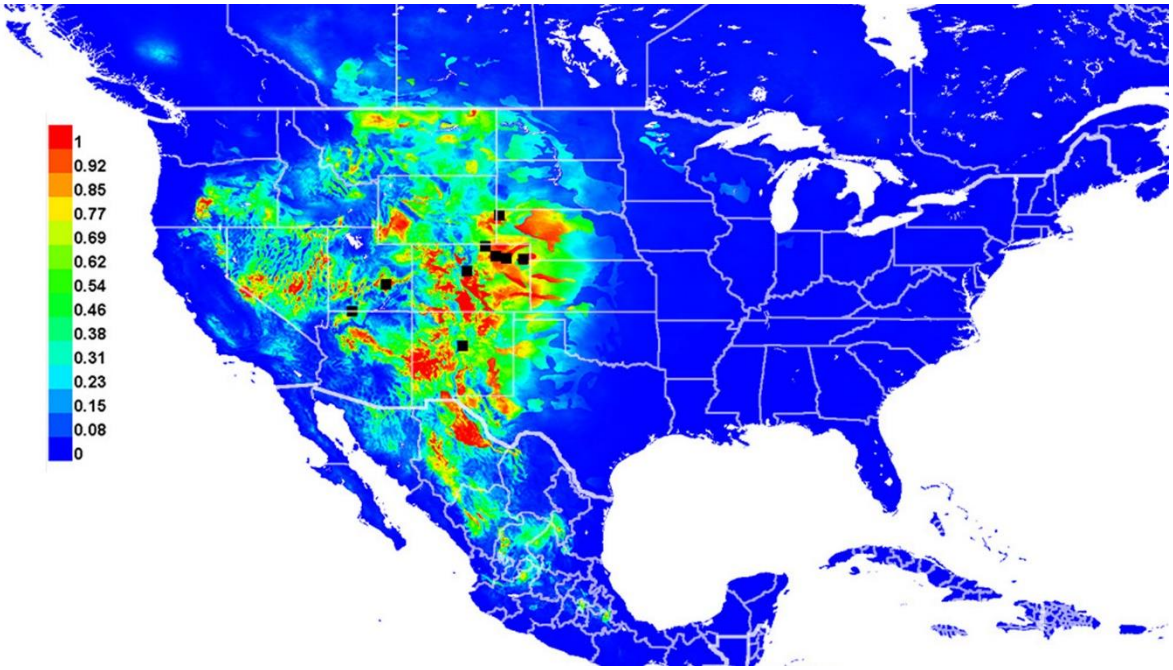


Figure 72. Georeferenced collection records of *Protandrena* (*Pterosarus*) *leucoptera* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *lutzae* (Cockerell)**

(Figure 73)

Panurginus lutzae Cockerell, 1922: 7. ♀. Holotype ♀ AMNH: 323872. Type locality: USA; Colorado: La Junta. 12 Aug 1920. 4100 ft. Examined specimen.

Panurginus lutzi Ascher and Pickering, 2017 (unjustified emendation)

Type specimens: Cockerell (1922) described *Panurginus lutzae* solely from the female holotype. The spelling *lutzi* has appeared in online checklists (ITIS.gov; Ascher & Pickering 2022), but is an unjustified emendation. Scott et al. (2011) use the correct spelling, but state that the type label miscites the spelling as ‘lutzi’. However, this is incorrect, and the label does read ‘lutzae.’

Diagnosis:

Females of *Pr*. (*Pt*.) *lutzae* can be recognized by their conically produced prosternum (contrast all except: *Pr*. *piercei*, *Pr*. *rudbeckiae*, *Pr*. *ehnesae*), and scutum punctures denser anteriorly (IS = 1 PD) sparser posteriorly (IS > 1 PD) (contrast remaining).

Material Examined:

USA – **Arizona** • 1♀; Apache, Nutrioso (1.5 km NE); 33.9677° N, 109.2039° W; 28 Aug. 2009; Griswold T.L. leg.; BBSL – **Colorado** • 5♀♀; Boulder, Dowe Flats, Lyons (4 mi. NE); 40.229° N, 105.347° W; elev. 1649 m.; 15 Sep. 1962; Lanham U.N., Vogel B. leg.; ex *Verbesina* sp.; UCMC • 1♀; Boulder; 40.094° N, 105.347° W; 06 Aug. 1926; Hicks C.H. leg.; UCMC • 1♀; same location as preceding; 13 Aug. 1925; Hicks C.H. leg.; UCMC • 1♀; El Paso, Foster Ranch; 38.734° N, 104.6502° W; elev. 1737 m.; 25 Aug. 1976; Brown F.M. leg.; UCMC • 1♀; Logan, Mertens; 40.5348° N, 103.4758° W; elev. 4357 m.; 18 Sep. 2014; UCMC • 1♀; Otero, La Junta; [37.985° N, 103.5438° W]; 12 Aug. 1920; Lutz F.E. leg.; AMNH • 1♀; Rio Grande, Del Norte; Road to Del Norte Peak; 37.5552° N, 106.4014° W; elev. 2398 m.; 04 Aug. 2019; Kircus M.B. leg.; UCMC – **New Mexico** • 4♀♀; Torrance, Moriarty; [34.9901° N, 106.0492° W]; 26 Aug. 1940; Milliron H.E. leg.; UMSP

Description

Female:

Structure: Body length range 6–7.12 mm. Head broader than long (HL/HW ratio 0.85). Face below antennae convex. Labral process trapezoidal, broader than long, apex rounded. Clypeus without median impressed line. Compound eyes parallel (UOD/LOD ratio 1). Posterior ocelli

0.33 mm apart. Flagellomeres broader than long. Dorsal pronotal carina absent. Prosternum conically produced. ITD 1.38 mm. Metapostnotum weakly extended medially <25% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.064 mm.

Sculpture: Clypeus punctation fine and sparse (IS = 1 PD). Paraocular punctation fine and sparse (IS = 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 1/2 way down antennal socket. Frons punctation fine and dense (IS < 1 PD). Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation very fine and sparse (IS = 1 PD) sparser posteriorly (IS > 1 PD). Scutellum punctation very fine and sparse (IS > 1 PD). Mesopleuron punctation fine and sparse (IS = 1 PD). Lateral propodeum finely reticulate. Posterior propodeum finely reticulate. Posterior propodeum tessellate. Dorsal face of T1 punctation impunctate. T2 basal impression shallow, approximately 1/4 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F5-F10 orange ventrally. Pronotal lobe black. Tegula brown. Wing veins light brown, stigma dark, membrane hyaline. tibia dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity medium-length, white. Mesopleuron pilosity long, white. Sternite pubescence colour yellow/brown. S3 pubescence medium length, sparse. S4 pubescence medium length, sparse. S5 pubescence long, medially directed apicolateral fringes.

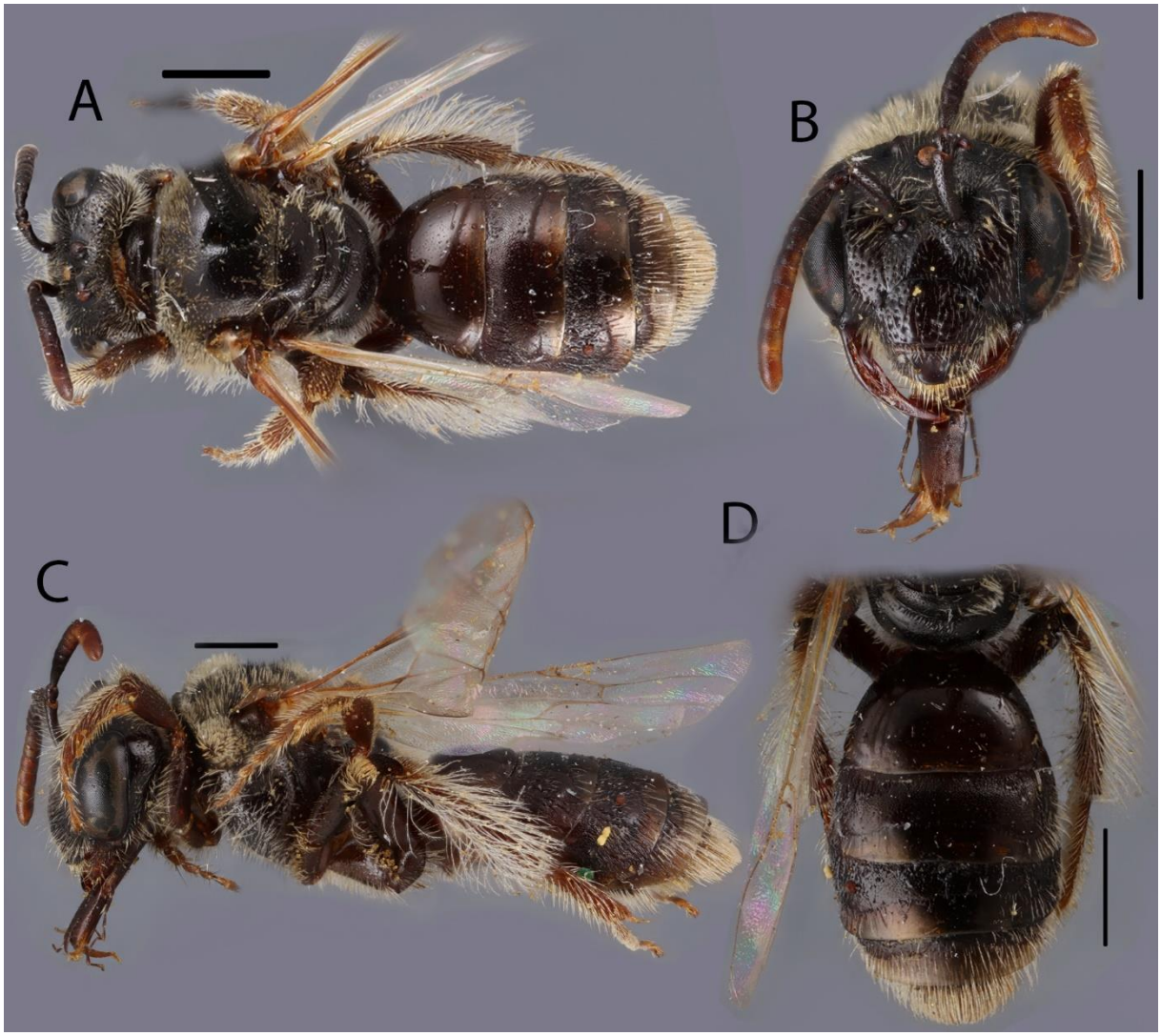


Figure 73. *Protandrena* (*Pterosarus*) *lutzae,* ♀. UMSP. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena lutzae* is active in August and September. Floral records for the species are poor, but all recorded specimens were caught on the genus *Verbesina*.

Range: USA (Arizona, Colorado, New Mexico).

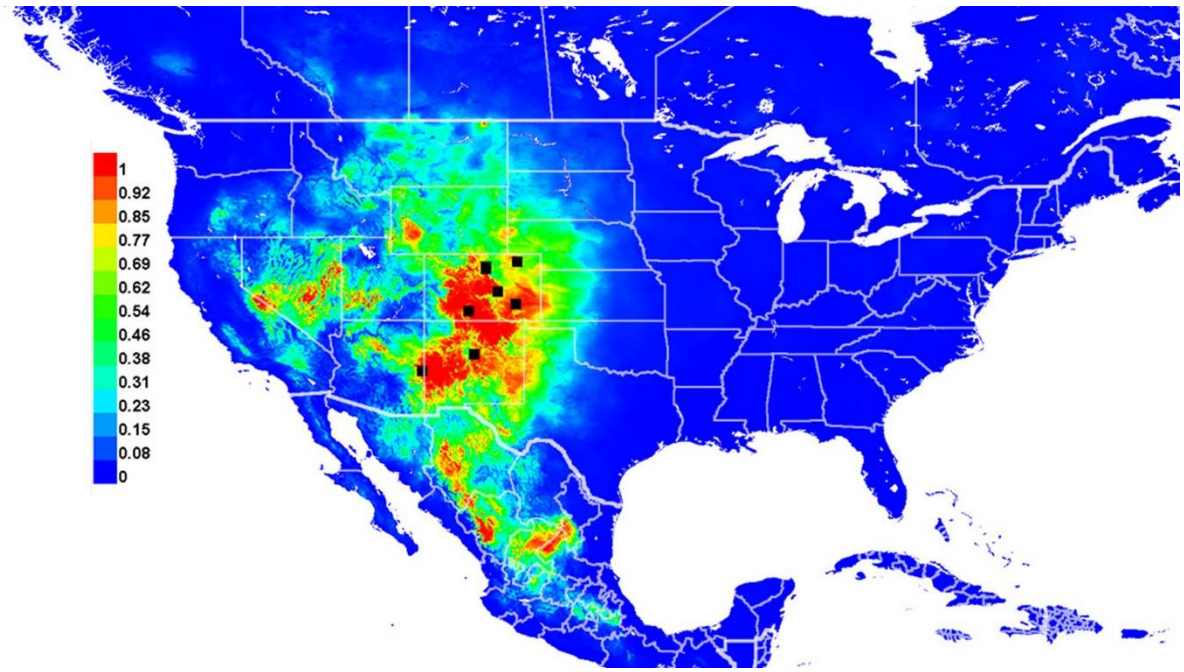


Figure 74. Georeferenced collection records of *Protandrena* (*Pterosarus*) *lutzae* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *luxsolaris* new species**

(Figure 75, Figure 76)

Holotype: ♂ Canada – British Columbia • South Okanagan, Osoyoos, Richter Pass; [49.0664481° N, 119.6009815° W]; 06 Jun. 1959; Madge R leg.

Etymology

The specific epithet *luxsolaris* is formed from the Latin noun ‘lux’ (‘light’) and adjective ‘solaris’ (‘of the sun’). This is in reference to the “Sunshine Coast” title of British Columbia, where the species is primarily found.

Diagnosis:

Males of *Pr*. (*Pt*.) *luxsolaris* can be recognized by a combination of their scutum punctures of two types coarse and very fine (contrast all except: *Pr. atricornis*, *Pr. citrinifrons*, *Pr. didirupa*, *Pr. occultata*, *Pr. prata*, *Pr. leucoptera*), mesopleuron punctures dense (IS < 1 PD) (contrast *Pr. citrinifrons*, *Pr. didirupa*, *Pr. occultata*, *Pr. prata*, *Pr. leucoptera*), and uniformly punctate scutellum (contrast remaining).

Females of *Pr*. (*Pt*.) *luxsolaris* can be recognized by a combination of their scutum punctures of two types coarse and very fine (contrast all except: *Pr. atricornis*, *Pr. citrinifrons*, *Pr. didirupa*, *Pr. occultata*, *Pr. prata*, *Pr. leucoptera*), and scutellum dense throughout (contrast remaining).

Material examined:

CANADA – **British Columbia** • 1♂; Okanagan, Penticton; [49.5° N, 119.5833° W]; 07 Jun. 1919; Anderson W.B. leg.; • 1♀; Okanagan-Similkameen, Naramata; [49.5861164° N, 119.6205219° W]; 28 May. 1958; Howden H., Howden A. leg.; • 1♂; South Okanagan, Osoyoos, Richter Pass; [49.0664481° N, 119.6009815° W]; 06 Jun. 1959; Kelton L.A. leg.; • 1♀; South Okanagan, Osoyoos; [49.0333° N, 119.4667° W]; 10 Jun. 1919; Buckell E.R. leg.; • 2♂♂; South Okanagan, Osoyoos, Richter Pass; [49.0664481° N, 119.6009815° W]; 06 Jun. 1959; Madge R leg.; • 2♂♂; same location as preceding; 06 Jun. 1959; Kelton L.A. leg.; • 1♂; Thompson-Nicola, Ashcroft, Barnes Lake; [50.701° N, 121.2482187° W]; 24 Jun. 2015; Hutchings G.E. leg.; ex *Erigeron filfolius*; • 1♂; Kentucky Allene Provincial Park; 49.75° N, 120.666667° W; 10 Jul. 1986; Goulet H. leg.; • 1♀; Madden Lake; [49.2319856° N, 119.6299419° W]; 03 Jul. 1959; Kelton L.A. leg.;

USA – **Wyoming** • 1♀, 2♂♂; Carbon, Battle Lake; [41.1516° N, 107.0056° W]; elev. 2591 m.; 18 Jul. 1961; Poole B.H. leg.;

Description

Male:

Structure: Body length range 5.43–7.35 mm. Head broader than long (HL/HW ratio 0.82). Face below antennae convex. Labral process trapezoidal, broader than long, apex emarginate. Clypeus without median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.26). Posterior ocelli 0.31 mm apart. Flagellomeres longer than broad. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.14 mm. Metapostnotum strongly extended medially >50% way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.19 mm. S6 notch deep, over 3/4 of disk, lateral carina absent.

Sculpture: Clypeus punctation fine and dense (IS < 1 PD). Paraocular punctation fine and dense (IS < 1 PD). Supraclypeal area punctation fine and dense (IS < 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 0.5 MOD from dorsal tangent of antennal socket. Frons finely reticulate. Vertex punctation fine and dense (IS < 1 PD). Mesoscutum punctation coarse and sparse (IS = 1 PD). Scutellum punctation coarse and dense (IS < 1 PD). Mesopleuron punctation coarse and dense (IS < 1 PD). Lateral propodeum finely reticulate. Posterior propodeum finely reticulate. Posterior propodeum not microsculptured. Dorsal face of T1 punctation fine and dense (IS < 1 PD). T2 basal impression shallow, approximately 1/3 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation sparse (IS = 1 PD).

Colour: Clypeus yellow. Supraclypeal area yellow to within 0.5 MOD of antennal socket. Lower paraocular area yellow to within 0.5 MOD of ventral tangent of antennal socket medially, extending along margin of compound eye terminating 1/2 way up antennal socket. Labral process yellow. Mandible yellow. Scape yellow anteriorly. Flagellomeres F2-F10 yellow ventrally. Pronotal lobe black. Tegula brown. Wing veins and stigma brown, membrane brown. Fore tibia yellow anteriorly dark posteriorly, mid and hind tibia yellow apically and basally. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity long, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence short, sparse. S4 pubescence short, sparse. S5 pubescence medium-length, medially directed apicolateral fringes.

Female:

Structure: Body length range 7.03–7.15 mm. Head broader than long (HL/HW ratio 0.81). Face below antennae convex. Labral process trapezoidal, broader than long, apex truncate. Clypeus without median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.06). Posterior ocelli 0.33 mm apart. Flagellomeres broader than long. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.36 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.083 mm.

Sculpture: Clypeus punctation fine and dense (IS < 1 PD). Paraocular punctation fine and dense (IS < 1 PD). Supraclypeal area punctation fine and dense (IS < 1 PD). Fovea clavate. Foveae converging above, narrow end terminating in line with ventral tangent of antennal socket. Frons finely reticulate. Vertex punctation fine and dense (IS < 1 PD). Mesoscutum punctation fine and sparse medially (IS > 1 PD) denser laterally (IS < 1 PD). Scutellum punctation fine and dense (IS

< 1 PD). Mesopleuron punctation fine and sparse (IS > 1 PD). Lateral propodeum punctation fine and dense (IS < 1 PD). Posterior propodeum punctation fine and dense (IS < 1 PD). Posterior propodeum not microsculptured. Dorsal face of T1 punctation fine and dense laterally (IS < 1 PD) sparser medially (IS > 1 PD). T2 basal impression shallow, approximately 1/2 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F2-F10 yellow ventrally. Pronotal lobe black. Tegula brown. Wing veins and stigma brown, membrane brown. Fore and mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity medium-length, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium-length, dense. S4 pubescence medium-length, dense. S5 pubescence medium-length, dense.

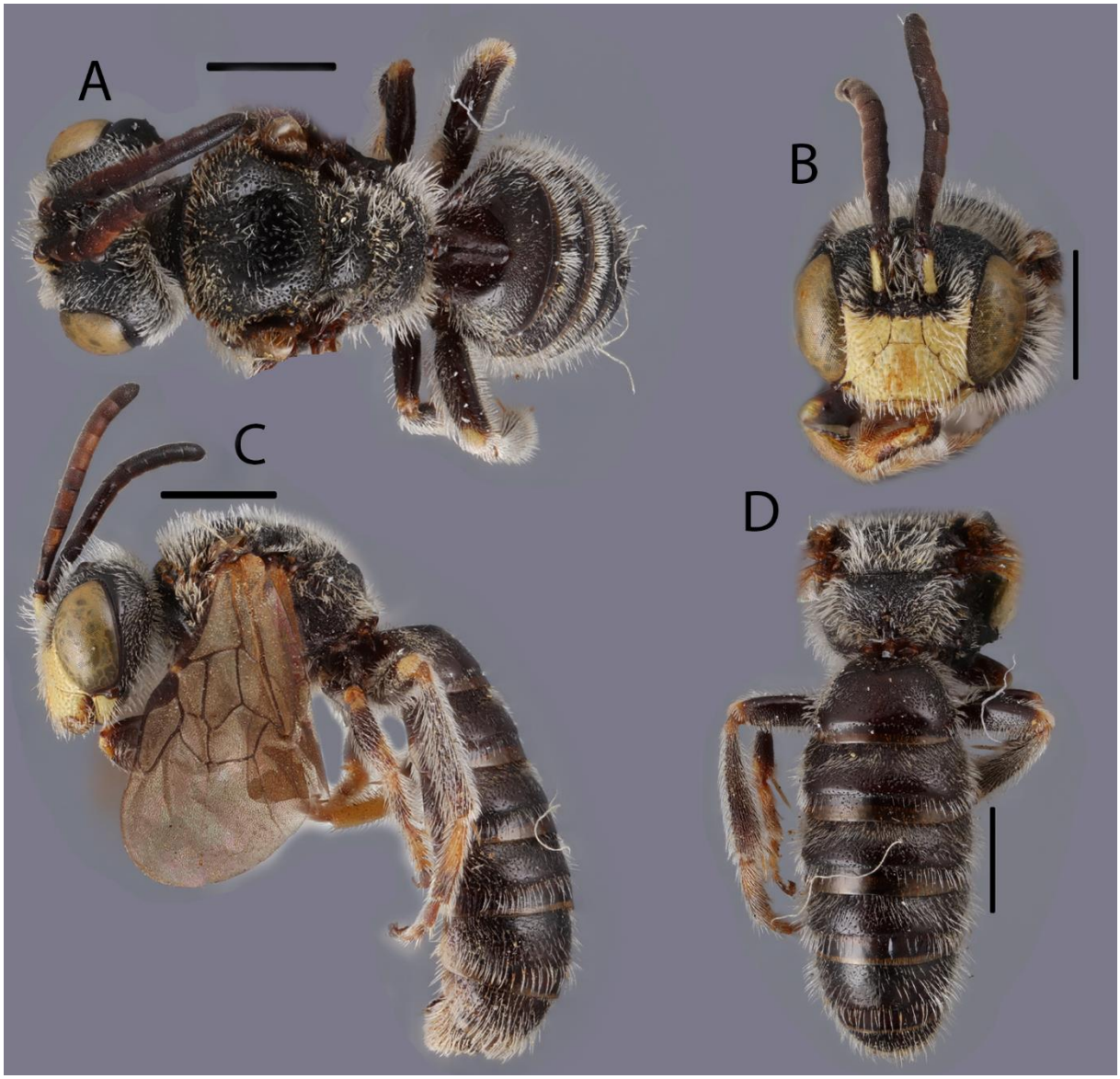


Figure 75. *Protandrena* (*Pterosarus*) *luxsolaris*, ♂. CNC. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

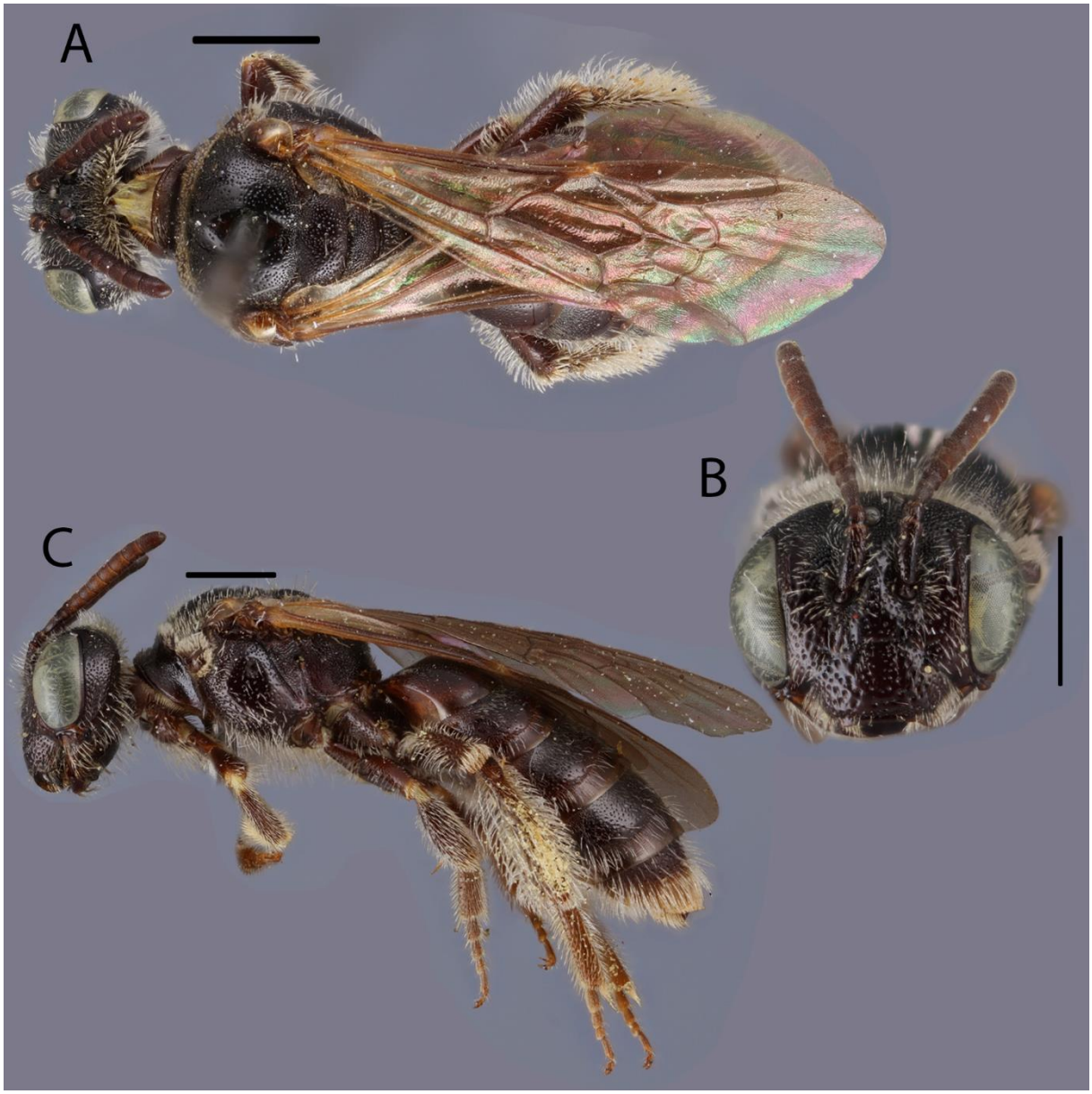


Figure 76. *Protandrena* (*Pterosarus*) *luxsolaris*, ♀. CNC. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena luxsolaris* is active from late May to mid-July. Only one floral record for the species exists, a male on *Erigeron filifolius*.

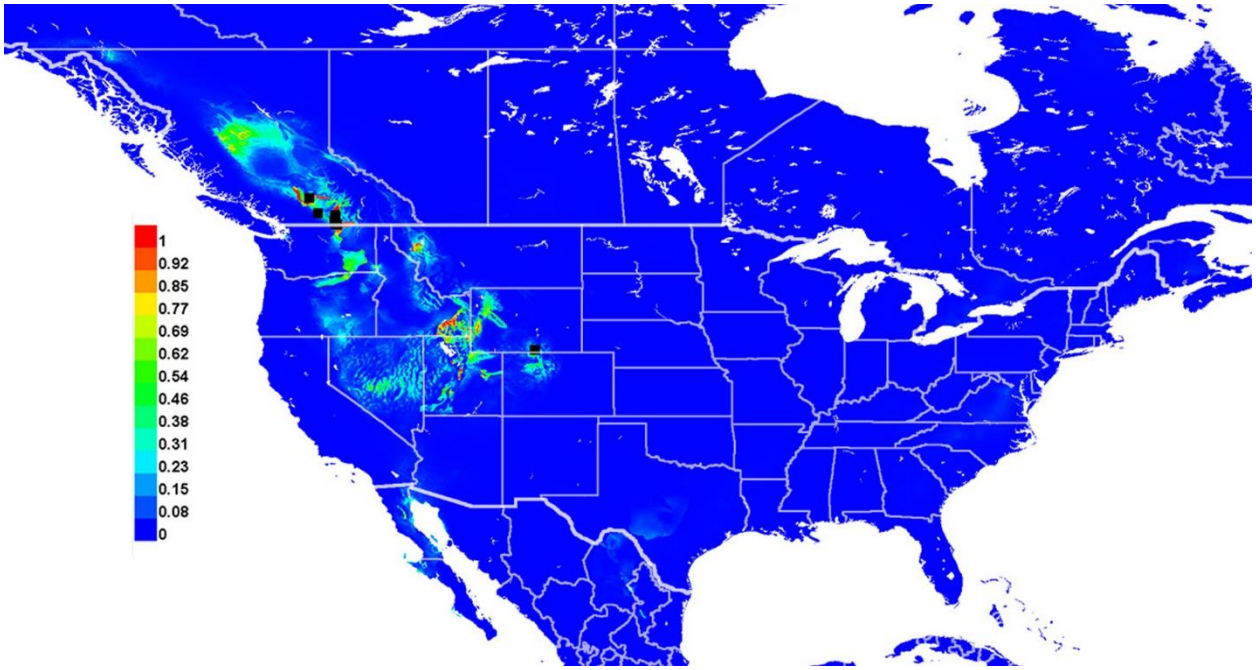


Figure 77. Georeferenced collection records of *Protandrena* (*Pterosarus*) *luxsolaris* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *nudescens* new species**

(Figure 78, Figure 79)

Holotype: ♂ USA – New Mexico • Rio Arriba, Ojo Caliente (10 mi. E); [36.3096° N, 105.8637° W]; 17 Aug. 1962; Rozen J.G., Rozen B.L. leg.; AMNH. AMNH_IZC 00292045

Diagnosis:

Males of *Pr*. (*Pt*.) *nudescens* can be recognized by a combination of their scutum that is reticulate anteriorly but punctate posteriorly (contrast all except: *Pr. aestivalis*, *Pr. alveus*, *Pr. andrenoides*, *Pr. barberi*, *Pr. bidentis*, *Pr. boylei*, *Pr. ehnesae*, *Pr. occidua*), reticulate posterior

face of propodeum (contrast *Pr. aestivalis, Pr. alveus, Pr. andrenoides, Pr. barberi, Pr. bidentis*), and yellow scapes but dark flagella (contrast remaining).

Females of *Pr.* (*Pt.*) *nudescens* can be recognized by a combination of their finely densely punctate posterior face of propodeum (IS < 1 PD) (contrast all except: *Pr. aestivalis, Pr. albitarsis, Pr. alveus, Pr. atricornis, Pr. dracomons, Pr. labrosiformis, Pr. leucoptera, Pr. ornatipes, Pr. subtilis, Pr. vigvierae*), scutum dense anteriorly (IS < 1 PD) sparse posteriorly (IS > 1 PD) (contrast *Pr. albitarsis, Pr. alveus, Pr. atricornis, Pr. dracomons, Pr. labrosiformis, Pr. leucopterus, Pr. ornatipes, Pr. subtilis, Pr. vigvierae*), and dark flagella (contrast *Pr. aestivalis*).

Material examined:

USA – **Arizona** • 1♂; Cochise, Huachuca Mountains, 5364 Ash Canyon Road; [31.3866° N, 110.2376° W]; Aug. 1993; McFarland N. leg.; CNC – **Colorado** • 1♂; Fremont, Coaldale; [38.3656° N, 105.7578° W]; elev. 1981 m.; 11 Aug. 1964; Michener C.D. leg.; SEMC • 1♂; same location as preceding; 11 Aug. 1968; Michener C.D. leg.; ex *Heterotheca villosa*; SEMC • 2♂♂; same location as preceding; 11 Aug. 1968; Michener C.D. leg.; ex *Grindelia squarrosa*; SEMC • 2♀♀; same location as preceding; 11 Aug. 1968; Michener C.D. leg.; ex *Heterotheca villosa*; SEMC – **New Mexico** • 1♂; Catron, Reserve (33 mi. SW); 33.3898° N, 108.9013° W; elev. 1497 m.; 11 Sep. 2009; Rozen J.G., Rozen K.C. leg.; AMNH • 1♂; Hidalgo, Animas (16 mi. S); [31.7247° N, 108.8257° W]; 23 Aug. 2007; Gibbs J. leg.; WRME • 1♂; Hidalgo, Animas (23.5 mi. S); 31.6184° N, 108.8674° W; 23 Aug. 2007; Ascher J.S., Dong C. leg.; AMNH • 2♂♂; Hidalgo, Animas (24.5 mi. S); [31.6116° N, 108.8654° W]; 23 Aug. 2007; Gibbs J. leg.; WRME • 1♂; Hidalgo, Animas (28 mi. S); 31.555° N, 108.876° W; 27 Aug. 2019; Gibbs J. leg.; WRME • 1♂; Hidalgo, Animas (28 mi. S); [31.5539° N, 108.8763° W]; 31 Aug. 2010; Ascher

J.S. leg.; AMNH • 1♂; Hidalgo, Animas (33 mi. S); [31.5018° N, 108.8779° W]; 29 Aug. 1982; Rozen J.G., Rozen B.L. leg.; AMNH • 1♂; Hidalgo, Junction of Rte 388 and Geronimo trail (4 mi. SW); [31.5181° N, 109.0165° W]; 02 Sep. 2013; Ascher J.S. leg.; AMNH • 1♂; Lincoln, Carrizozo (13.3 mi NNE); 33.8361° N, 109.8322° W; elev. 1680 m.; 16 Sep. 1999; Brooks R. leg.; ex *Machaerenthera tanacetifolia*; SEMC • 1♂; McKinley, Gallup (19 mi. N); [35.8129° N, 108.7659° W]; 14 Aug. 1972; Rozen J.G., McGinley R. leg.; AMNH • 2♀♀, 2♂♂; Rio Arriba, Ojo Caliente (10 mi. E); [36.3096° N, 105.8637° W]; 17 Aug. 1962; Rozen J.G., Rozen B.L. leg.; AMNH – **Utah** • 1♂; San Juan; [37.4634° N, 109.7592° W]; 28 Aug. 1958; Knowlton G.F. leg.; OSUC

Description

Male:

Structure: Body length range 5.25–5.75 mm. Head broader than long (HL/HW ratio 0.91). Face below antennae convex. Labral process trapezoidal, broader than long, apex truncate. Clypeus without median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.27). Posterior ocelli 0.27 mm apart. Flagellomeres longer than broad. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.01 mm. Metapostnotum strongly extended medially >50% way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.13 mm. S6 notch shallow only 1/3, lateral carina absent.

Sculpture: Clypeus punctation fine and dense (IS < 1 PD). Paraocular punctation fine and dense (IS < 1 PD). Supraclypeal area punctation fine and sparse (IS = 1 PD). Fovea ovate. Foveae slightly convergent above, posterior end terminating 1 MOD from dorsal tangent of antennal socket. Frons finely reticulate. Vertex punctation fine and dense (IS < 1 PD). Mesoscutum

punctation finely reticulate anteriorly sparser posteriorly (IS < 1 PD). Scutellum punctation fine and dense (IS < 1 PD). Mesopleuron punctation fine and dense (IS < 1 PD). Lateral propodeum finely reticulate. Posterior propodeum coarsely reticulate. Posterior propodeum imbricate. Dorsal face of T1 punctation fine and dense (IS < 1 PD) impunctate medially. T2 basal impression deep, approximately 1/2 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus yellow. Supraclypeal area yellow to within 0.5 MOD of antennal socket. Lower paraocular area yellow reaching ventral tangent of antennal socket medially, extending along margin of compound eye terminating halfway to dorsal tangent of antennal socket. Labral process yellow. Mandible yellow. Scape yellow anteriorly. Flagellomeres dark. Pronotal lobe yellow. Tegula brown. Wing veins and stigma brown, membrane smoky. Fore tibia yellow anteriorly dark posteriorly, mid and hind tibia yellow apically and basally. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity medium-length, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium length, dense. S4 pubescence medium length, dense. S5 pubescence long, medially directed apicolateral fringes.

Female:

Structure: Body length range 6.17–6.32 mm. Head broader than long (HL/HW ratio 0.87). Face below antennae convex. Labral process anchor shaped, broader than long, apex rounded. Clypeus without median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.04). Posterior ocelli 0.29 mm apart. Flagellomeres broader than long. Dorsal pronotal carina extends laterally to pronotal lobes. Prosternum not produced. ITD 1.25 mm. Metapostnotum

strongly extended medially >50% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.059 mm.

Sculpture: Clypeus punctation fine and sparse (IS = 1 PD). Paraocular punctation coarse and sparse (IS = 1 PD). Supraclypeal area punctation fine and sparse (IS = 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 1/2 way down antennal socket. Frons punctation fine and dense (IS < 1 PD). Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation fine and dense anteriorly (IS < 1 PD) sparse posteriorly (IS > 1 PD). Scutellum punctation fine and sparse (IS > 1 PD) denser medially (IS < 1 PD). Mesopleuron punctation fine and sparse (IS = 1 PD). Lateral propodeum finely reticulate. Posterior propodeum punctation fine and dense (IS < 1 PD). Posterior propodeum tessellate. Dorsal face of T1 punctation extremely minute and sparse (IS > 5 PD). T2 basal impression shallow, basal 1/4 of T2 lineolate. T3 punctation sparse (IS > 1 PD). T4 punctation sparse (IS > 1 PD).

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres dark. Pronotal lobe black. Tegula brown. Wing veins and stigma brown, membrane smoky. Fore and mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi 2 – 4 dark, basitarsus yellow.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity medium-length, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium length, sparse. S4 pubescence medium length, sparse. S5 pubescence long, medially directed apicolateral fringes.

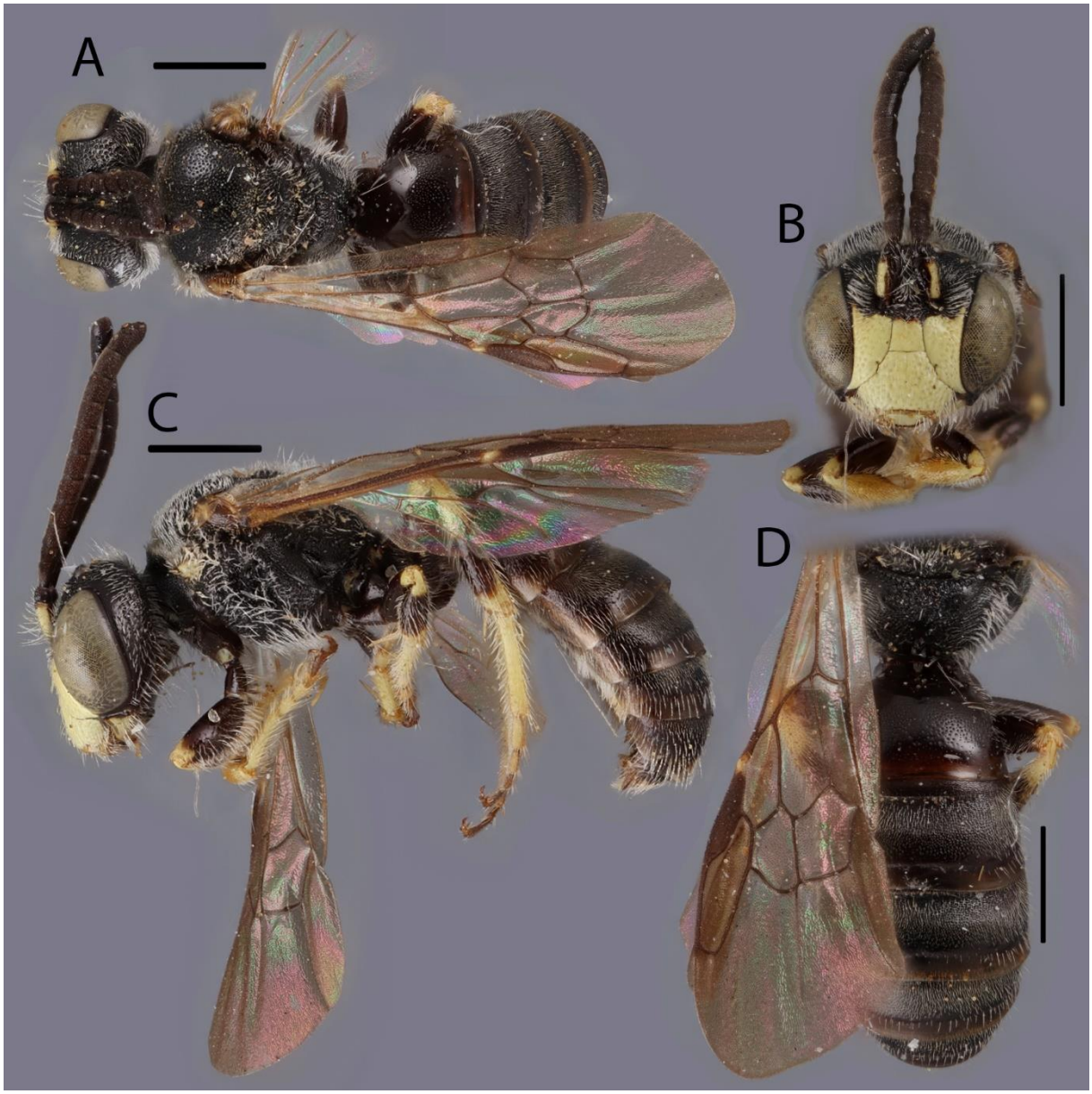


Figure 78. *Protandrena* (*Pterosarus*) *nudescens*, ♂. AMNH_00292045. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

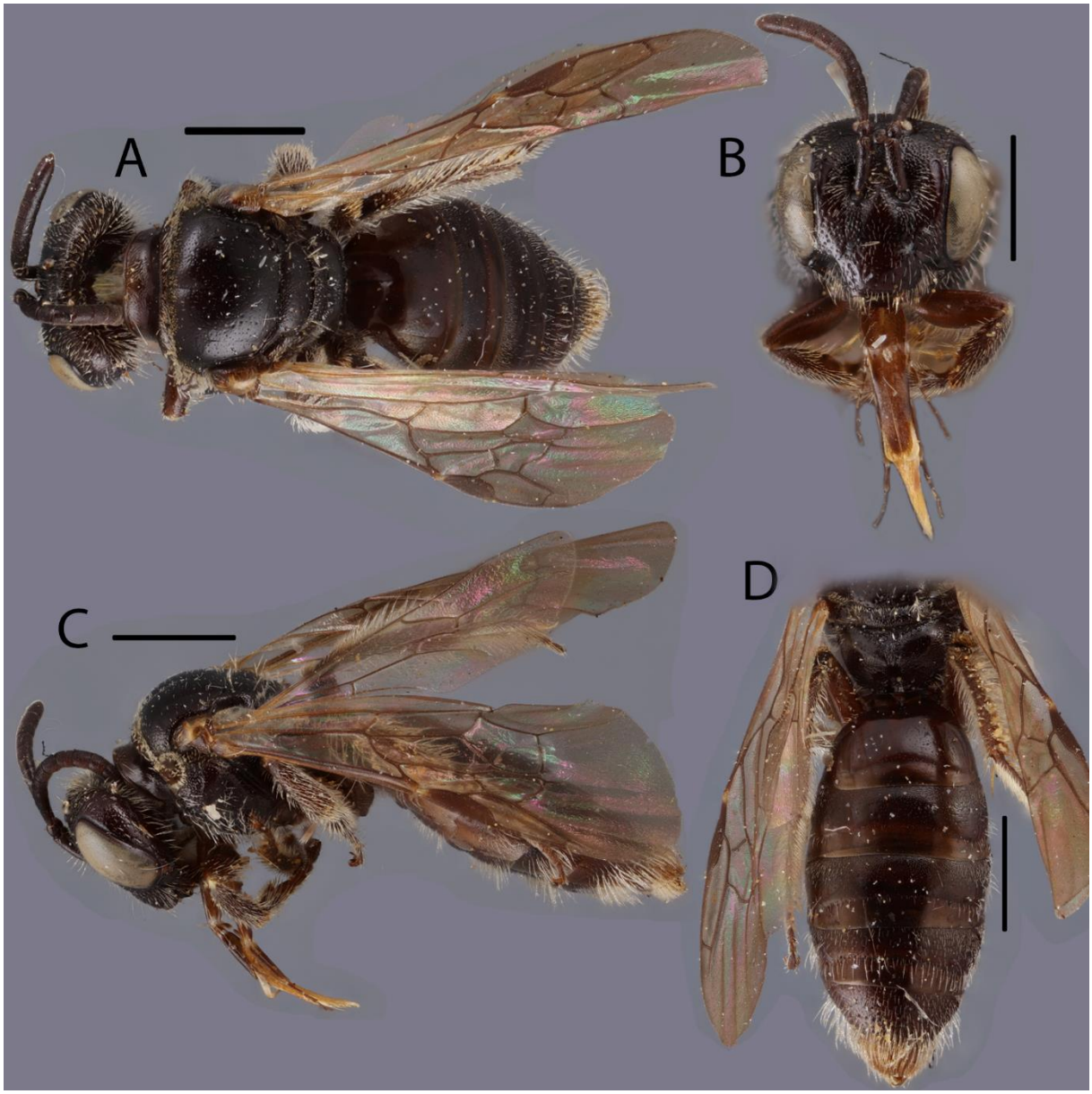


Figure 79. *Protandrena* (*Pterosarus*) *nudescens*, ♀. AMNH_00292093. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena nudescens* is active in August and September. Floral records are poor for the species, but all records are on the tribe Astereae. There are only two female specimens with floral records, both from *Chrysopsis villosa*.

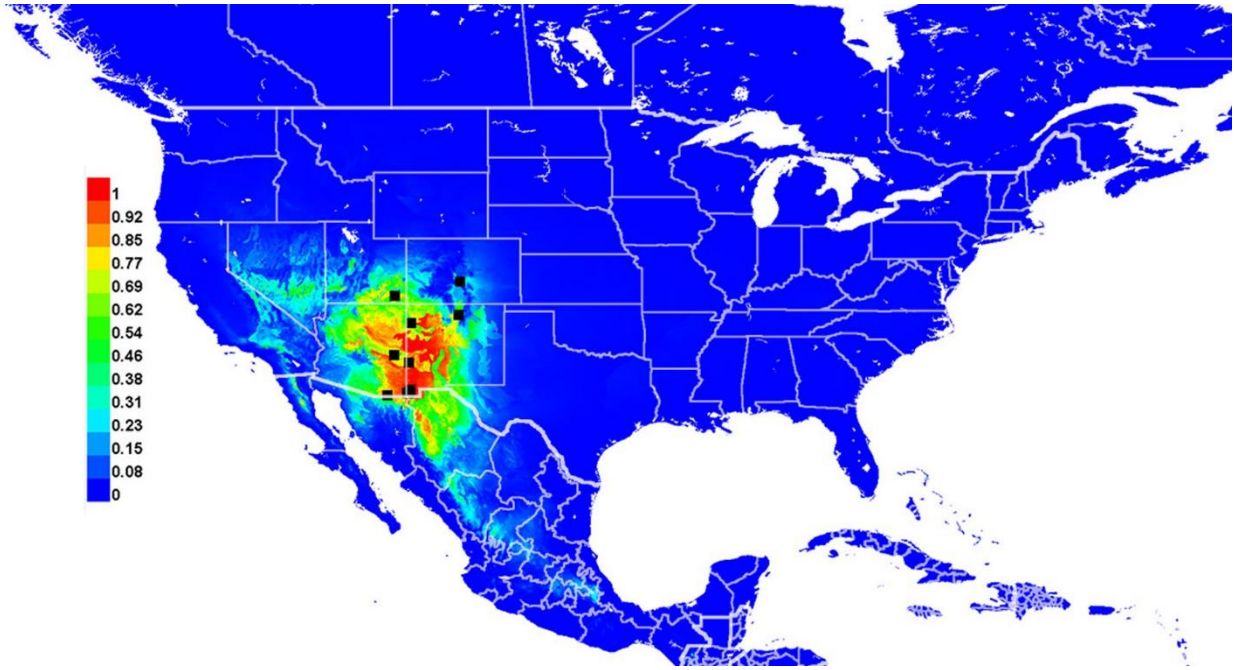


Figure 80. Georeferenced collection records of *Protandrena* (*Pterosarus*) *nudescens* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *occidua* (Timberlake)**

(Figure 81, Figure 82)

Pseudopanurgus (*Pterosarus*) *occiduus* Timberlake, 1967: 14. ♀.Holotype ♀ CAS 15417. Type locality: USA; Arizona: Prescott. 1 Sep 1930. ex. *Xanthisma gracile*. Examined specimen.

Taxonomy: Rozen, 1966: 7–8 (larva, as species A).

Type specimens: Timberlake (1967) described *Pseudopanurgus* (*Pterosarus*) *occidua* from both males and females. 12 males and 30 females were examined. A female at the University of California Riverside was selected as the holotype.

Diagnosis:

Males of *Pr*. (*Pt*.) *occidua* can be recognized by a combination of their scutum reticulate anteriorly and finely densely punctate posteriorly (IS < 1 PD) (contrast all except: *Pr*. *aestivalis*, *Pr*. *alveus Pr*. *andrenoides*, *Pr*. *boylei*, *Pr*. *nudescens*), reticulate posterior propodeum (contrast *Pr*. *boylei*, and *Pr*. *nudescens*), and yellow scapes and flagella (contrast remaining).

Females of *Pr*. (*Pt*.) *occidua* can be recognized by a combination of their fine and dense scutum punctures (IS < 1 PD) (contrast all except: *Pr*. *albipes*, *Pr*. *citripes*, *Pr*. *ornatipes*, *Pr*. *renimaculata*, *Pr*. *subtilis*, *Pr*. *vigvierae*), yellow pronotal lobes (contrast *Pr*. *citripes*, *Pr*. *renimaculata*, *Pr*. *subtilis*, *Pr*. *vigvierae*), and quadrate labral process (contrast remaining).

Material examined:

MEXICO – **Zacatecas** • 1♂; Tropic of Cancer hwy 54; [23.45° N, 102.186° W]; elev. 1958 m.; 04 Jul. 1986; Carroll, Friedlander, Schaffner leg.; TAMUIC

USA – **Arizona** • 1♂; Cochise, Apache (18 mi. SW); [31.4971° N, 109.3306° W]; 21 Sep. 1973; Ehrenfeld J.G., Ehrenfeld D.W. leg.; AMNH • 1♀; Cochise, Bisbee (5 mi. NE); [31.4985° N, 109.8609° W]; 13 Aug. 1994; Ascher J.S. leg.; AMNH • 1♀; Cochise, Chiricahua Mountains, Chiricahua Monument; [32.0136° N, 109.3423° W]; 04 Sep. 1999; Danforth, Magnacca leg.; CUIC • 2♀♀, 2♂♂; Cochise, Chiricahua Mountains, West Turkey Creek Road; [31.8646° N, 109.3585° W]; 03 Sep. 1987; Rozen J.G., Rozen B.L. leg.; ex *Heterotheca* sp.; AMNH • 1♂; same location as preceding; 02 Sep. 2003; Rozen J.G., Ascher J.S., Staff R.L., Edwards R.E. leg.; AMNH • 2♀♀; Cochise, Chiricahua National Monument; [32.0136° N, 109.3423° W]; elev. 1554 m.; 04 Sep. 1985; Shinn A.F. leg.; SEMC • 2♀♀; same location as preceding; 14 Sep. 1985; Shinn A.F. leg.; SEMC • 1♂; Cochise, Portal, Southwest Research Station; [31.884° N, 109.2061° W]; 24 Aug. 2007; Ascher J.S., Dong C. leg.; AMNH • 1♀; same location as

preceding; 14 Sep. 1962; Rozen J.G. leg.; ex Haplopappas sp.; AMNH • 1♀; same location as preceding; 17 Sep. 1962; Rozen J.G. leg.; ex *Heterotheca subaxillaris*; AMNH • 1♀; same location as preceding; 21 Sep. 1962; Rozen J.G. leg.; ex *Heterotheca subaxillaris*; AMNH • 1♀; same location as preceding; 02 Sep. 1987; Tanner G. leg.; AMNH • 1♂; same location as preceding; 24 Aug. 1968; Rozen J.G., Favreau leg.; AMNH • 1♂; Cochise, Portal, Southwest Research Station (8km N); 31.9039° N, 109.295° W; elev. 1620 m.; 27 Aug. 2000; Brooks R. leg.; SEMC • 3♂♂; Cochise , Portal (5 mi. W); [31.9148° N, 109.2243° W]; 26 Aug. 2007; Gibbs J. leg.; WRME • 2♂♂; Douglas, Apache (15 mi. SW); [31.5727° N, 109.2594° W]; 24 Aug. 1996; Rozen J.G., Rozen B.L. leg.; ex *Heterotheca subaxillaris*; AMNH • 1♀; Graham, Mount Graham; [32.7017° N, 109.8715° W]; elev. 2134 m.; 21 Aug. 1997; McAdams B., Rozen J.G. leg.; AMNH • 1♀, 2♂♂; Santa Cruz, Lyle Canyon Road; [31.5119° N, 110.4875° W]; elev. 1550 m.; 29 Aug. 2000; Brooks R. leg.; ex *Erigeron* divergens; SEMC • 1♂; Yavapai, Kirkland; [34.4316° N, 112.7435° W]; 31 Aug. 1964; Michener C.D., Michener D.R. leg.; ex *Heterotheca subaxillaris*; SEMC • 1♀; Yavapai, Prescott; [34.54° N, 112.4685° W]; 01 Sep. 1930; Timberlake P.H. leg.; CAS – **New Mexico** • 1♀; Hidalgo, Animas (16 mi. S); [31.7247° N, 108.8257° W]; 23 Aug. 2007; Gibbs J. leg.; WRME • 1♀; Hidalgo, Animas (20 mi. S); [31.6686° N, 108.8413° W]; 12 Sep. 1977; Rozen J.G., Rozen B.L. leg.; AMNH • 4♀♀; same location as preceding; 13 Sep. 1977; Rozen J.G., Rozen B.L. leg.; AMNH • 1♀; Hidalgo, Animas (20 mi. S); [31.5849° N, 108.8702° W]; 12 Sep. 1976; Rozen J.G. leg.; AMNH • 1♀; Hidalgo, Animas (22 - 25 mi. S); [31.6184° N, 108.8674° W]; 10 Sep. 1976; Rozen J.G. leg.; AMNH • 1♀; Hidalgo, Rodeo; [31.8354° N, 109.0312° W]; 19 Sep. 1976; AMNH

Description

Male:

Structure: Body length range 4.8–5.95 mm. Head broader than long (HL/HW ratio 0.88). Face below antennae convex. Labral process quadrate, about equal, apex truncate. Clypeus without median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.23). Posterior ocelli 0.27 mm apart. Flagellomeres longer than broad. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.02 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.13 mm. S6 notch shallow, less than 1/3 of disk, lateral carina absent.

Sculpture: Clypeus punctation fine and sparse (IS = 1 PD). Paraocular punctation fine and sparse (IS = 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea ovate. Foveae slightly convergent above, posterior end terminating 0.5 MOD from dorsal tangent of antennal socket. Frons finely reticulate. Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation finely reticulate anteriorly sparser posteriorly (IS < 1 PD). Scutellum punctation fine and dense (IS < 0.5 PD) finely reticulate medially. Mesopleuron punctation coarse and dense (IS < 1 PD). Lateral propodeum finely reticulate. Posterior propodeum finely reticulate. Posterior propodeum tessellate. Dorsal face of T1 punctation fine and dense (IS < 1 PD) impunctate medially. T2 basal impression deep, approximately 1/2 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus yellow. Supraclypeal area yellow to within 1 MOD of antennal socket. Lower paraocular area yellow extending along compound eyes terminating 1/2 way to dorsal tangent of antennal socket. Labral process yellow. Mandible yellow. Scape yellow anteriorly. Flagellomeres F3-F7 yellow anteriorly. Pronotal lobe yellow. Tegula yellow. Wing veins and stigma brown,

membrane light brown. Fore tibia yellow anteriorly dark posteriorly, mid tibia with dark spot anteriorly, yellow posteriorly, hind tibia with reduced dark spot on the apical anterior. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, yellow/brown. Scutellum pilosity of two forms long and medium-length, yellow/brown. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium length, sparse. S4 pubescence medium length, sparse. S5 pubescence medium length, medially directed apicolateral fringes.

Female:

Structure: Body length range 5.25–6.58 mm. Head broader than long (HL/HW ratio 0.84). Face below antennae convex. Labral process quadrate, longer than broad, apex truncate. Clypeus without median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.05). Posterior ocelli 0.3 mm apart. Flagellomeres broader than long. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.22 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.062 mm.

Sculpture: Clypeus punctation coarse and sparse (IS = 1 - 1.5 PD). Paraocular punctation coarse and sparse (IS = 1 - 1.5 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea clavate. Foveae slightly convergent above, narrow end terminating in line with dorsal tangent of antennal socket. Frons punctation fine and dense (IS < 0.5 PD). Vertex punctation coarse and dense (IS < 0.5 PD). Mesoscutum punctation fine and dense (IS < 1 PD). Scutellum punctation fine and dense (IS < 1 PD) reticulate medially and on borders. Mesopleuron punctation rugose sparser posteriorly (IS = 1PD). Lateral propodeum punctation reticulate. Posterior propodeum punctation reticulate. Posterior propodeum imbricate. Dorsal face of T1 punctation fine and

sparse (IS > 3 PD) impunctate medially. T2 basal impression shallow, reticulate where impression should be. T3 punctation dense (IS < 1 PD). T4 punctation sparse (IS > 1 PD).

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F3-F10 yellow ventrally. Pronotal lobe yellow. Tegula light brown. Wing veins and stigma brown, membrane light brown. tibia dark, except for yellow spot at knee. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity of two forms long and short, white. Mesopleuron pilosity long, white. Sternite pubescence colour yellow/brown. S3 pubescence medium length, sparse. S4 pubescence medium length, sparse. S5 pubescence medium length, medially directed apicolateral fringes.

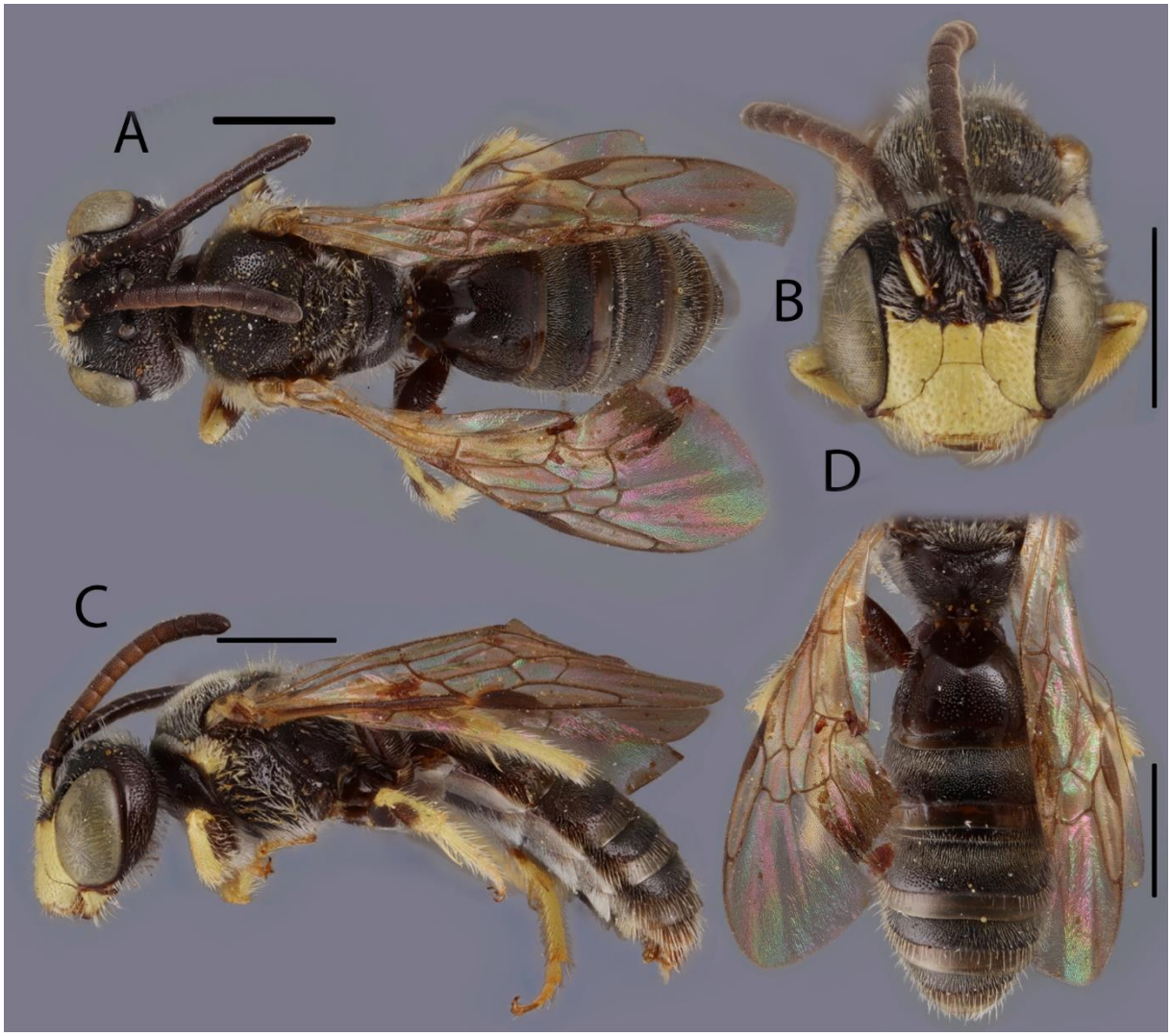


Figure 81. *Protandrena* (*Pterosarus*) *occidua*, ♂. AMNH_00292004. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

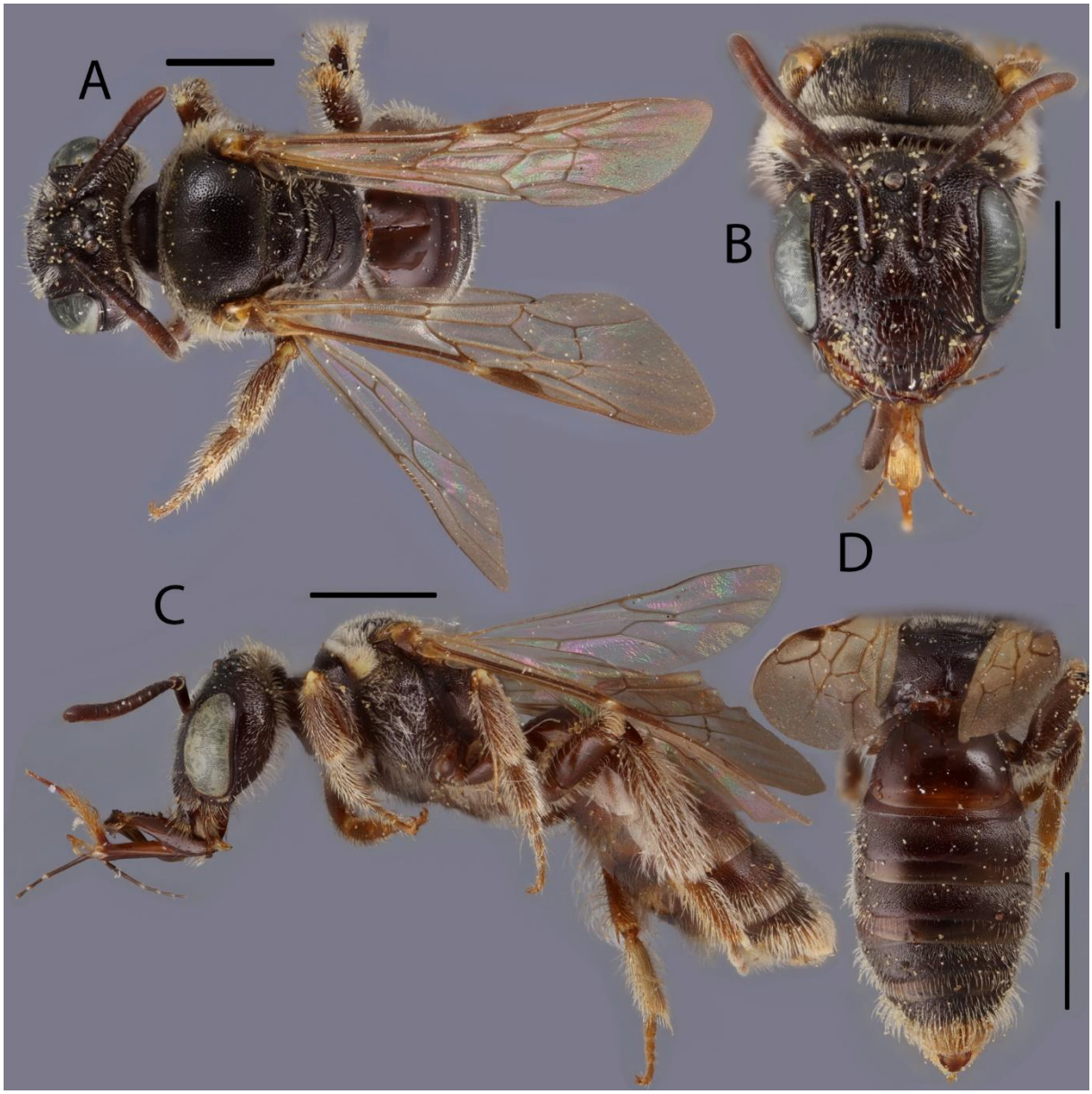


Figure 82. *Protandrena* (*Pterosarus*) *occidua*, ♀. AMNH_00292017. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological Notes: *Protandrena occidua* is active from early August to late September. Rozen (1965) recorded the parasite of *Protandrena occidua* ("as unnamed *Pseudopanurgus*") as *Holcopasites arizonicus*. Rozen (1966) described and illustrated the larvae of *Protandrena*

occidua (as *Pseudopanurgus* species A). Most floral records for the species are from the tribe Astereae.

Range: Mexico (Zacatecas), USA (Arizona, New Mexico).

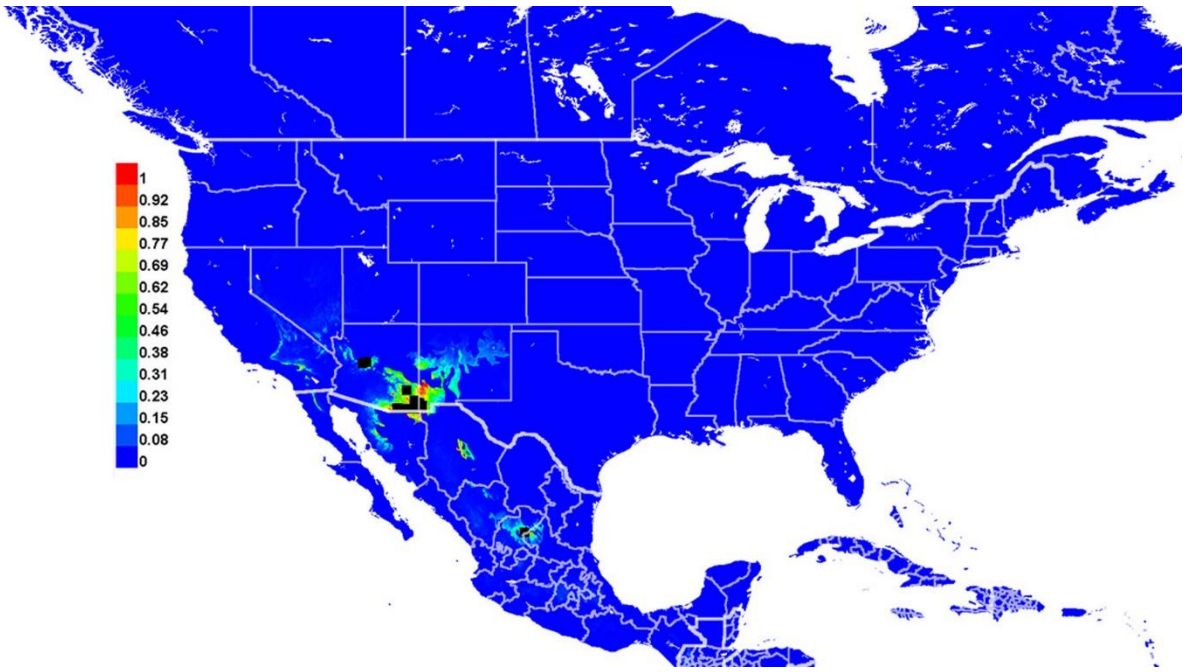


Figure 83. Georeferenced collection records of *Protandrena* (*Pterosarus*) *occidua* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *occultata* new species**

(Figure 84, Figure 85)

Etymology:

The specific epithet is *occultata* is formed from the Latin occultatum (‘hidden’) referring to the ability of the species to “hide in plain sight” by commonly being misidentified as *Pr. boylei*.

Diagnosis:

Males of *Pr*. (*Pt*.) *occultata* can be recognized by a combination of their scutum punctures that are dense anteriorly sparse posteriorly (contrast all except: *Pr*. *albertensis, Pr*. *irregularis, Pr*. *labrosa, Pr*. *labrosiformis, Pr*. *rudbeckiae*), dark pronotal lobes (contrast *Pr*. *albertensis, Pr*. *labrosa, Pr*. *labrosiformis, Pr*. *rudbeckiae*), and finely reticulate posterior face of propodeum (contrast *Pr*. *irregularis*)

Females of *Pr*. (*Pt*.) *occultata* can be recognized by a combination of their T1 finely densely punctate laterally, sparse medially (contrast all except: *Pr*. *albitarsis* and *Pr*. *luxsolaris*) and finely reticulate posterior face of propodeum (contrast remaining).

Material examined:

MEXICO – **Hidalgo** • 2♀♀; Actopan (4.4 mi SE); [20.2185° N, 98.9136° W]; elev. 2057 m.; 27 Aug. 1962; Ordway, Marston leg.; SEMC

USA – **Arizona** • 1♂; Cochise, Chiricahua Mountains, West Turkey Creek Road; [31.864621° N, 109.358537° W]; 10 Sep. 1987; Rozen J.G., Rozen B.L. leg.; ex *Heterotheca* sp.; AMNH • 1♀; Cochise, Portal (14.2 mi. W); 31.9137° N, 109.2667° W; elev. 2599 m.; 20 Aug. 2000; Neff J.L. leg.; ex *Erigeron neomexicanus*; CTMI • 2♂♂; Cochise, Portal (2 mi. NE); [31.9137° N, 109.1414° W]; 03 Sep. 1961; Cazier M. leg.; AMNH • 1♀; same location as preceding; 17 Sep. 1960; Cazier, Feigh leg.; AMNH • 5♀♀, 3♂♂; Cochise, Portal (5 mi. W), Southwest Research Station; [31.884° N, 109.2061° W]; elev. 1646 m.; 11 Sep. 1966; Arnaud P.H. leg.; CAS • 1♂; same location as preceding; 09 Sep. 1966; Arnaud P.H. leg.; CAS • 1♀; same location as preceding; 30 Sep. 1966; Arnaud P.H. leg.; CAS • 1♂; same location as preceding; 13 Sep. 1966;

Arnaud P.H. leg.; CAS • 1♂; same location as preceding; 10 Sep. 1966; Arnaud P.H. leg.; CAS • 1♂; same location as preceding; 16 Sep. 1966; Arnaud P.H. leg.; CAS • 1♀; same location as preceding; 24 Sep. 1966; Arnaud P.H. leg.; CAS • 1♀; same location as preceding; 06 Sep. 1966; Arnaud P.H. leg.; CAS • 1♀; same location as preceding; 19 Sep. 1966; Arnaud P.H. leg.; CAS • 1♀; Cochise, Portal, San Simon Road; [31.9137° N, 109.1414° W]; 08 Sep. 1999; Danforth, Magnacca leg.; CUIC • 1♀, 2♂♂; Cochise, Portal, Southwest Research Station; [31.884° N, 109.2061° W]; elev. 1646 m.; 12 Sep. 1962; Rozen J.G. leg.; ex *Verbesina encelioides*; AMNH • 3♀♀; same location as preceding; 22 Sep. 1963; Rozen J.G. leg.; AMNH • 1♂; same location as preceding; 31 Aug. 1956; Ordway E. leg.; AMNH • 1♂; same location as preceding; 20 Jun. 1966; Rozen J.G., Rozen B.L. leg.; ex *Verbesina encelioides*; AMNH • 1♀; same location as preceding; 11 Sep. 1976; Rozen J.G. leg.; AMNH • 1♀; same location as preceding; 04 Sep. 1962; Statham M. leg.; AMNH • 1♀; same location as preceding; 01 Sep. 1962; Rozen J.G., Statham M., Hessel S.J. leg.; AMNH • 1♀; Cochise, Rustler Park (1 mi. NE); 31.913333° N, 109.279167° W; 20 Aug. 2000; Griswold T.L. leg.; BBSL – **Colorado** • 1♂; Boulder, Boulder; 40° N, 105.25° W; 07 Aug. 1919; AMNH • 1♂; Denver, Denver; [39.7392° N, 104.9847° W]; 28 Aug. 1919; AMNH • 1♀; Larimer, Estes Park; 40.377° N, 105.522° W; elev. 2305 m.; 13 Aug. 1919; UCMC – **New Mexico** • 1♀; Grant, Gila National Forest, McMillan Campground (1.5 km NE); 33.934° N, 108.2032° W; 02 Sep. 2010; Griswold T.L. leg.; ex *Erigeron* sp.; BBSL • 1♂; Guadalupe, Santa Rosa; [34.9387° N, 104.6825° W]; 22883; Triplehorn C.A., W.E. leg.; OSUC • 1♂; Hidalgo, Roadforks (5 mi. S); [32.2305° N, 108.9584° W]; 06 Sep. 1987; Rozen J.G., Rozen B.L. leg.; AMNH • 1♀; Hidalgo, Rodeo (12 mi. N); [32.015639° N, 109.035846° W]; 27 Aug. 2008; Ascher J.S., Dong C. leg.; AMNH • 1♀; Lincoln, Ruidoso; 33.57° N, 105.611667° W; elev. 2100 m.; 29 Sep. 1999; Brooks R. Michener C.D. leg.; SEMC • 2♂♂;

same location as preceding; 29 Sep. 1999; Brooks R. Michener C.D. leg.; ex *Verbesina encelioides*; SEMC • 1♂; Santa Fe, Santa Fe; 35.6786° N, 105.9558° W; elev. 655 m.; July; Cockerell T.D.A. leg.; ex On Composite; UCMC – **Texas** • 1♂; Brewster, Marathon (24 mi. E); 30.119° N, 102.521° W; 06 Sep. 2002; Neff J.L. leg.; ex *Verbesina encelioides*; CTMI • 1♂; Jeff Davis, Davis Mountains, Madera Canyon; [30.7501° N, 104.0838° W]; 01 Jul. 1948; Vaurie P., Vaurie C. leg.; AMNH

Description

Male:

Structure: Body length range 6.23–7.27 mm. Head broader than long (HL/HW ratio 0.84). Face below antennae convex. Labral process trapezoidal, broader than long, apex emarginate. Clypeus with median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.24). Posterior ocelli 0.33 mm apart. Flagellomeres longer than broad. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.3 mm. Metapostnotum not extended medially. Tarsi 2–4 triangular. Fore tarsi width 0.18 mm. S6 notch shallow only 1/3, lateral carina absent.

Sculpture: Clypeus punctation coarse and dense (IS < 1 PD). Paraocular punctation fine and sparse medially (IS > 1) denser laterally (IS < 1). Supraclypeal area punctation fine and sparse (IS = 1 PD). Fovea clavate. Foveae slightly converging above, narrow end terminating in line with dorsal tangent of antennal socket. Frons coarsely reticulate. Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation fine and dense anteriorly (IS < 1 PD) sparser posteriorly (IS > 1 PD). Scutellum punctation fine and sparse laterally (IS > 1 PD) denser medially (IS < 1 PD). Mesopleuron punctation coarse and dense (IS < 1 PD). Lateral propodeum finely reticulate. Posterior propodeum finely reticulate. Posterior propodeum tessellate. Dorsal

face of T1 punctation fine and dense (IS < 1 PD). T2 basal impression deep, approximately 1/2 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus yellow. Supraclypeal area yellow terminates in line with paraocular mark. Lower paraocular area yellow extending along margin of compound eye terminating ~0.5 MOD from antennal socket. Labral process yellow. Mandible yellow. Scape black. Flagellomeres dark. Pronotal lobe black. Tegula light brown. Wing veins and stigma brown, membrane hyaline. Fore tibia yellow anteriorly dark posteriorly, remaining tibia with small apical and basal yellow spot. Tarsi yellow.

Pubescence: Mesoscutum pilosity long, yellow/brown. Scutellum pilosity long, yellow/brown. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium length, dense. S4 pubescence medium length, dense, with medially directed apicolateral fringes. S5 pubescence long, medially directed apicolateral fringes.

Female:

Structure: Body length range 6.58–8.4 mm. Head broader than long (HL/HW ratio 0.81). Face below antennae convex. Labral process U shaped, longer than broad, apex rounded. Clypeus without median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.01). Posterior ocelli 0.36 mm apart. Flagellomeres broader than long. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.52 mm. Metapostnotum weakly extended medially <25% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.07 mm.

Sculpture: Clypeus punctation fine and sparse (IS > 1 PD). Paraocular punctation fine and sparse (IS > 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea ovate. Foveae

converging above, posterior end terminating 2/3 down antennal socket. Frons punctation fine and dense (IS < 1 PD). Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation fine and sparse (IS > 2 PD). Scutellum punctation fine and sparse laterally (IS > 2 PD) denser medially (IS = 1 PD). Mesopleuron punctation fine and sparse medially (IS > 1 PD) denser along borders (IS < 1 PD). Lateral propodeum finely reticulate. Posterior propodeum finely reticulate. Posterior propodeum tessellate. Dorsal face of T1 punctation fine and dense laterally (IS < 1 PD) sparser medially (IS > 6 PD). T2 basal impression shallow, approximately basal 1/4 of T2 puncto-lineolate. T3 punctation dense (IS < 1 PD). T4 punctation sparse (IS = 1 PD).

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F3-F9 orange ventrally. Pronotal lobe black. Tegula light brown. Wing veins and stigma light brown, membrane hyaline. Fore and mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity medium-length, yellow/brown. Scutellum pilosity long, yellow/brown. Mesopleuron pilosity long, yellow. Sternite pubescence colour yellow/brown. S3 pubescence medium length, sparse. S4 pubescence medium length, sparse. S5 pubescence long, medially directed apicolateral fringes.

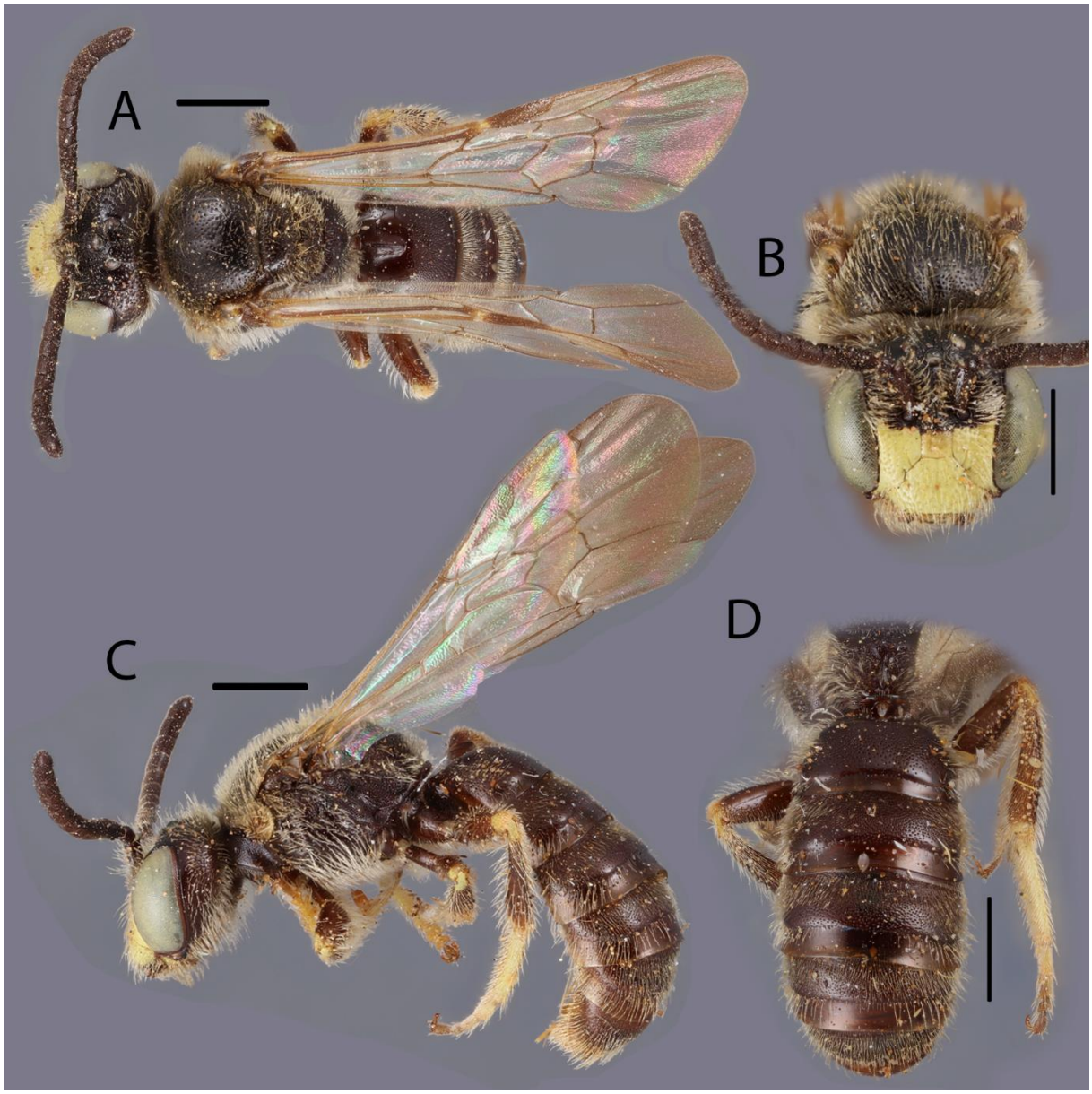


Figure 84. *Protandrena* (*Pterosarus*) *occultata*, ♂. AMNH_00291913. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

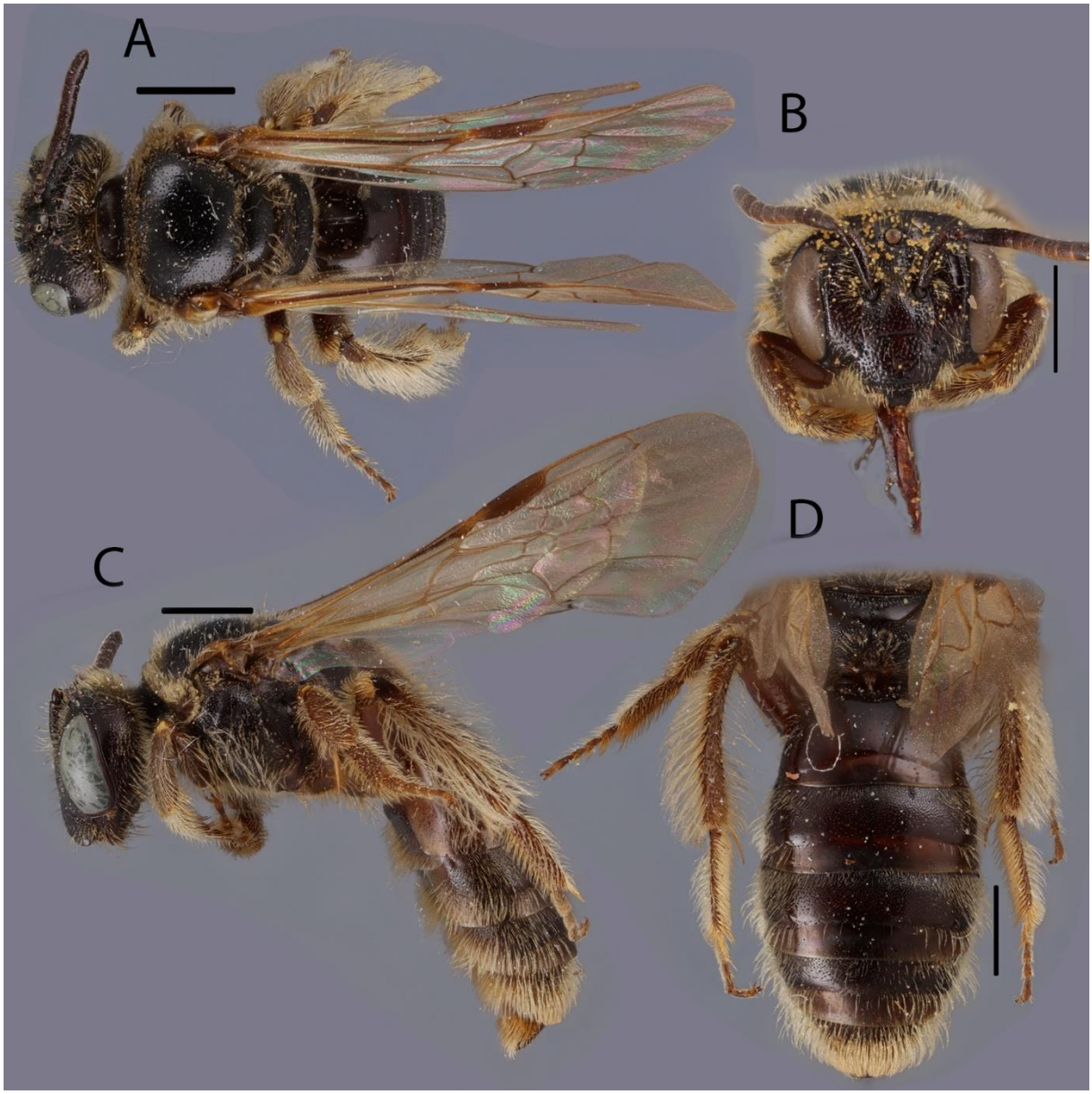


Figure 85. *Protandrena* (*Pterosarus*) *occultata*, ♀. AMNH_00292005. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena occultata* is a summer-flying bee active from mid-June to late September. Rozen, (1967, 1989) described the nest architecture, pollen provision, and egg structure within nest cells (as *Ps. boylei*). Nests are described having entrances at or near stones

on rocky soil, with some burrow openings being under the stones as well. Lateral tunnels leading from the main burrow are approximately three to five centimeters long. Cells are provisioned and excavated proceeding downward, with the oldest at the top. The cells are constructed at an angle of approximately 45 degrees, with the entrance being higher than the back. The egg and pollen provision dimensions as described by Rozen (1967) are as follows: Horizontal diameter of egg 3.8 mm, vertical diameter of egg 3.0 mm. horizontal diameter of pollen provision 1.9 mm, vertical diameter of pollen provision 0.5 mm. Rozen (1967) also recorded *Holcopasites insoletus* as a brood parasite of *Protandrena occultata* (as *Ps. boylei*). Pierce (1918) recorded *Crawfordia cockerelli* (Pierce 1909) as the parasite of *Protandrena occultata* (as *Pr. boylei*). Floral records for the species are poor, (Hurd 1979) recorded pollen collection from *Verbesina encelioides*.

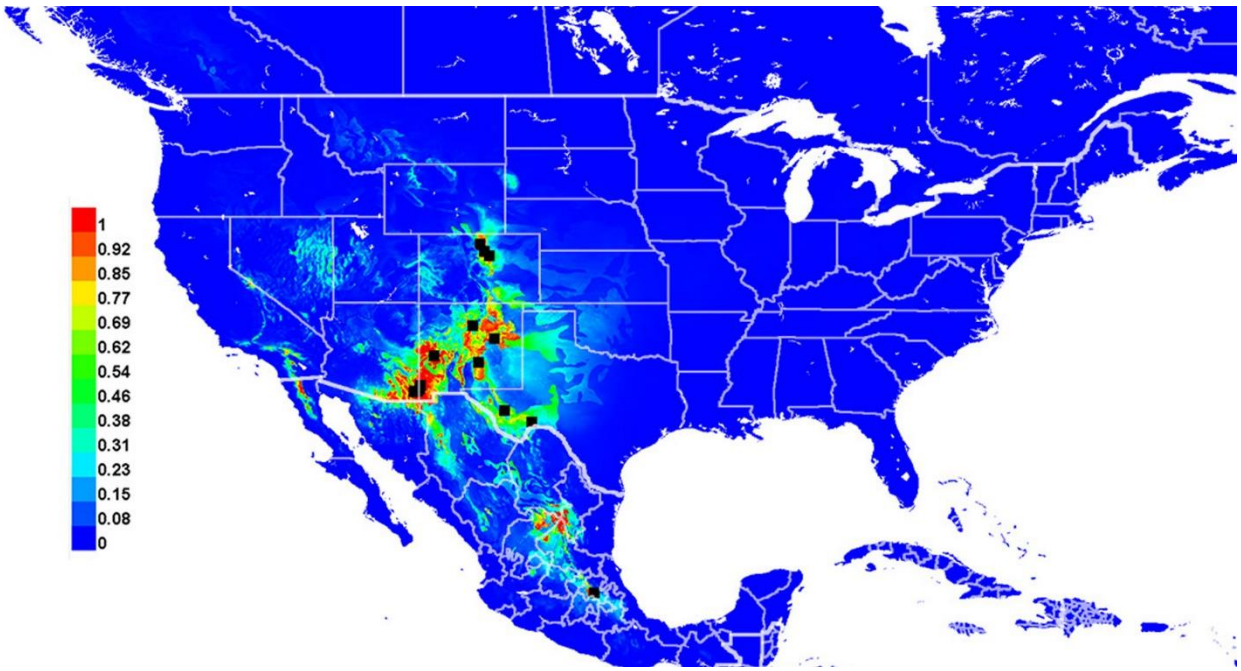


Figure 86. Georeferenced collection records of *Protandrena* (*Pterosarus*) *occultata* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *ornatipes* (Cresson)**

(Figure 87, Figure 88)

Panurgus ornatipes Cresson, 1872: 260. ♂. Lectotype ♂ ANSP: 2205 Lectotype designation by Cresson 1916. Type locality: USA; Texas: Bosque. Examined by photos.

Taxonomy: Crawford, 1912: 368. (tax. characters).

Type specimens: Cresson (1872) described *Panurgus ornatipes* from four male syntypes. Cresson (1916) designated a specimen from the ANSP as the name bearing lectotype.

Diagnosis:

Males of *Pr*. (*Pt*.) *ornatipes* can be recognized by a combination of their uniformly fine and dense scutum punctures (IS < 1 PD) (contrast all except: *Pr. albipes, Pr. aurifodinae, Pr. bilobata, Pr. perlaevis, Pr. piercei, Pr. planafacialis, Pr. quadrapylae, Pr. vigvierae*), posterior face of propodeum not notably dulled by microsculpture (contrast remaining)..

Females of *Pr*. (*Pt*.) *ornatipes* can be recognized by a combination of their yellow pronotal lobes (contrast all except: *Pr. albipes, Pr. alveus, Pr. amor, Pr. barberi, Pr. labrosa, Pr. occidua, Pr. quadrapylae, Pr. ximenesiae*), uniformly fine and dense scutum punctures (IS < 1 PD) (contrast *Pr. alveus, Pr. amor, Pr. barberi, Pr. labrosa, Pr. quadrapylae, Pr. ximenesiae*), yellow maculation on face (contrast remaining).

Material examined:

MEXICO – **Chihuahua** • 1♀; Cd. Camargo (27 km N); [27.94° N, 105.24° W]; 27 Aug. 1991; Griswold T. leg.; SEMC • 1♀; Chihuahua (27 km N); [28.95° N, 106.28° W]; 29 Aug. 1991; Minckley R.L. leg.; ex Dyssodia sp.; SEMC

USA – **Colorado** • 2♀♀; Costilla, Eastdale; Dean Swift Flower Farm; 37.0182° N, 105.6118° W; elev. 2316 m.; 15 Sep. 2019; Kircus M.B. leg.; UCMC • 2♀♀; Rio Grande, Monte Vista NWR; Bunkhouse; 37.4619° N, 106.165° W; elev. 2338 m.; 20 Aug. 2019; Kircus M.B. leg.; ex *Chrysothamnus* sp.; UCMC • 1♀; Teller, Florissant, Florissant Fossil Beds National Monument Headquarters area; 38.9063° N, 105.2791° W; elev. 2560 - 2591 m.; 19 Aug. 1980; Brown F.M. leg.; ex *Erigeron* sp.; UCMC – **Kansas** • 2♀♀, 1♂; Caldwell, Caldwell; 37.04° N, 97.6208° W; elev. 450 m.; 01 Oct. 1999; Michener C.D. Brooks R. leg.; ex *Gutierrezia* sp.; SEMC • 1♀; Chase, Elmdale; [38.3736° N, 96.6447° W]; 30 Sep. 1975; Michener C.D., Chabot leg.; SEMC • 1♂; Chase, Elmdale (2 mi W); [38.3831° N, 96.6846° W]; 30 Sep. 1975; Michener C.D., Chabot leg.; SEMC • 1♀, 1♂; Cowley, Rock; 37.36° N, 97° W; elev. 475 m.; 01 Oct. 1999; Michener C.D. Brooks R. leg.; ex *Amphiachyris dracunuloides*; SEMC • 1♀, 1♂; Douglas; [38.9108° N, 95.2684° W]; 09 Sep. 1949; Michener, Beamer leg.; ex *Amphiachyris dracunuloides*; SEMC • 1♀; Greenwood, Eureka; [37.8239° N, 96.2892° W]; 07 Sep. 1949; Michener C.D., Beamer leg.; ex *Amphiachyris* sp.; SEMC • 1♂; Greenwood, Reece; [37.7989° N, 96.4464° W]; 07 Sep. 1949; Michener C.D., Beamer leg.; ex *Amphiachyris dracunuloides*; SEMC – **New Mexico** • 8♀♀; Bernalillo, Albuquerque Academy; [35.152° N, 106.552° W]; 29 Sep. 2002; Torchio P.F. leg.; ex *Gutierrezia sarothrae*; BBSL • 2♀♀; same location as preceding; 07 Oct. 2002; Torchio P.F. leg.; ex *Sphaeralcea* sp.; BBSL • 1♀; Catron, New Horse Springs (13.5 mi. SW), Junction 28 and 47 (1.5 mi. S); 33.789° N, 108.3496° W; 26 Aug. 2000; Hicks A.L., Scott V. leg.; UCMC • 1♀; Rio Arriba, Cebolla (1 mi. S); [36.5236° N, 106.482° W]; 26 Sep. 2007; Torchio P.F. leg.;

ex Dieteria canescens; BBSL • 13♀♀; Sandoval, Bernalillo (12 mi. W); [35.3203° N, 106.7546° W]; 15 Sep. 2003; Torchio P.F. leg.; ex *Gutierrezia* sp.; BBSL • 2♀♀; same location as preceding; 08 Sep. 2003; Torchio P.F. leg.; ex *Gutierrezia* sp.; BBSL • 1♀, 2♂♂; Sandoval, San Ysidro (12 mi. N); [35.7328° N, 106.7648° W]; 27 Aug. 2003; Torchio P.F. leg.; ex *Sphaeralcea* sp.; BBSL • 2♂♂; same location as preceding; 28 Aug. 2003; Torchio P.F. leg.; ex *Sphaeralcea* sp.; BBSL – **Oklahoma** • 1♀; Kiowa, Lone Wolf (7 mi SW); [34.9089° N, 99.3225° W]; 03 Jun. 1979; Michener C.D. leg.; ex *Thelesperma filifolium*; SEMC – **Texas** • 1♂; Bee, Beeville; [28.4008° N, 97.7483° W]; 25 Apr. 1982; Bickel, Sharkey leg.; CUIC • 1♂; Bexar, San Antonio; [29.4241° N, 98.4936° W]; 20 May. 1918; Bradley J.C. leg.; CUIC • 1♀; Bexar, San Antonio, San Antonio Loop 13; [29.3568° N, 98.4944° W]; 24 Aug. 1952; Washbauer M. leg.; ex Baccharis sp.; AMNH • 3♀♀; Bexar; [29.4201° N, 98.5721° W]; 07 Nov. 1954; Alex A.H. leg.; ex *Symphyotrichum* sp.; TAMUIC • 2♂♂; Bosque, Walnut Springs (3 mi. S); [32.0146° N, 97.7481° W]; 02 May. 1975; Schaffner J.C. leg.; TAMUIC • 1♂; Bosque; [31.8508° N, 97.6982° W]; 1872; Belfrage G.W. leg.; ANSP • 1♀; Brazos; [30.6521° N, 96.6211° W]; 12 Oct. 1962; Alex A.H. leg.; ex *Croptilon divaricatum*; TAMUIC • 1♀; Callahan, Baird (10 mi S); [32.2575° N, 99.4014° W]; 27 May. 1978; Michener C.D. leg.; ex *Engelmannia pinnatifida*; SEMC • 1♂; Cameron, Brownsville; [25.9017° N, 97.4975° W]; Apr. 1978; Johnson W.L. leg.; MEM • 1♀; Crosby; [33.55° N, 101.2524° W]; 03 Jun. 1980; Col B. leg.; TAMUIC • 1♀; Fayette, La Grange; [29.9055° N, 96.8766° W]; 19 Apr. 1952; Michener, Wille, Beamer, LaBerge leg.; SEMC • 1♀; Gillespie, Fredericksburg; [30.2752° N, 99.1403° W]; 16 Apr. 1959; McAlpine J.F. leg.; CNC • 2♂♂; Gillespie, Stonewall; [30.236° N, 98.6645° W]; 18 Apr. 1953; Beamer R.H. leg.; SEMC • 1♀, 1♂; same location as preceding; 16 Apr. 1963; Beamer R.H. leg.; SEMC • 1♀; same location as preceding; 19 Apr. 1953; Beamer R.H. leg.; SEMC • 1♀; Hays, Henly;

[30.1946° N, 98.2108° W]; 16 Apr. 1953; Beamer L.D. leg.; SEMC • 15♀♀, 2♂♂; Kerr, Kerrville; [30.0474° N, 99.1403° W]; 17 Apr. 1959; Mason W.R.M. leg.; CNC • 3♀♀, 2♂♂; same location as preceding; 18 Apr. 1959; Mason W.R.M. leg.; CNC • 1♂; same location as preceding; 19 Apr. 1959; Mason W.R.M. leg.; CNC • 1♂; same location as preceding; 21 Apr. 1959; McAlpine J.F. leg.; CNC • 1♂; same location as preceding; 29 Mar. 1959; Mason W.R.M. leg.; CNC • 1♀; same location as preceding; 30 Mar. 1959; Mason W.R.M. leg.; CNC • 1♀; Lea; 32.4117° N, 103.6817° W; 24 Sep. 1979; Murray R.R., Schaffner J.C. leg.; TAMUIC • 1♀; Montegue, Forestburg, Near Forestburg; [33.5332° N, 97.5567° W]; 1940; Bridwell L.H. leg.; UCMC • 1♂; Nueces, Corpus Christi; [27.8006° N, 97.3964° W]; 28 Mar. 1952; Knull D.J., J.N. leg.; OSUC • 1♂; Pecos, Imperial; [31.2729° N, 102.6926° W]; 02 May. 1954; Beamer L.D. leg.; SEMC • 1♂; same location as preceding; 10 May. 1954; Beamer L.D. leg.; SEMC • 1♀, 1♂; Schleicher, El Dorado; [29.4753° N, 95.2083° W]; 10 Apr. 1950; Beamer, Stephen, Michener, Rozen leg.; SEMC • 1♂; Travis, Austin, Brackenridge Field Station; [30.2843° N, 97.7804° W]; 20 Apr. 1988; Eickwort G.C., Neff J.L. leg.; CUIC • 1♂; Travis, Austin, Hornsby Bend Research Area; 30.235° N, 97.653° W; 29 Apr. 2013; Neff J.L. leg.; ex *Helenium amarum* var. *badium*; CTMI • 2♀♀, 1♂; same location as preceding; 08 May. 2013; Neff J.L. leg.; ex *Helenium amarum* var. *badium*; CTMI • 2♂♂; Uvalde, Uvalde; [29.2097° N, 99.7862° W]; 14 Apr. 1952; Michener, Wille, Beamer, LaBerge leg.; SEMC • 1♀; Wichita, Wichita Falls; [33.9137° N, 98.4934° W]; 08 Oct. 1994; Segelquist K. leg.; SEMC • 2♀♀; Wilbarger, Vernon (15 mi. N); [34.1545° N, 99.2651° W]; 27 May. 1978; Michener C.D. leg.; ex *Engelmannia pinnatifida*; SEMC – **Utah** • 1♂; Emery, Ferron; [39.0936° N, 111.1332° W]; 14 Jul. 1956; Knowlton G.F. leg.; SEMC • 1♀; Garfield, Burr Trail, Horse Pasture Mesa (3.9 mi. S); [37.6516° N, 111.0715° W]; 11 Sep. 2002; Topham L. leg.; ex *Chrysothamnus depressus*; BBSL

• 1♀; Garfield, Burr Trail, Studhorse parks (1 mi. E); [37.8648° N, 111.3005° W]; 28 Aug. 2002; Davidson C. leg.; ex *Gutierrezia sarothrae*; BBSL • 1♀; Garfield, Escalante (3.75 mi. WNW), Escalante River ; [37.7714° N, 111.6698° W]; 30 Aug.; Hawk J leg.; ex *Chrysothamnus depressus*; BBSL • 1♀; Garfield, White Canyon Flat; [37.9254° N, 111.1386° W]; 28 Aug. 2002; Topham L. leg.; ex *Gutierrezia sarothrae*; BBSL • 1♀; Iron, Buckskin Valley, Near Middle Spring Wash and Highway 20; 38.8611° N, 112.5903° W; 27 Aug. 2009; Griswold T.L. leg.; ex *Ericameria* sp.; BBSL • 1♀; Kane, Kitchen Corral Point (0.35 mi. W); [37.2115° N, 112.1228° W]; 04 Sep. 2003; Griswold T.L. leg.; ex *Gutierrezia sarothrae*; BBSL • 4♀♀; Kane, Mouth of Lick Wash (1.13 mi. W); [37.3225° N, 112.1581° W]; 10 Sep. 2003; Highbee S. leg.; ex *Gutierrezia sarothrae*; BBSL • 1♀; Kane, Red Wash, Carly Knoll (2 mi. SSE); [37.2783° N, 112.2945° W]; 24 Aug. 2001; Andrus R. leg.; ex *Gutierrezia sarothrae*; BBSL

Description

Male:

Structure: Body length range 4.83–6.5 mm. Head broader than long (HL/HW ratio 0.83). Face below antennae convex. Labral process quadrate, about equal, apex truncate. Clypeus without median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.32). Posterior ocelli 0.3 mm apart. Flagellomeres about equal in length and width. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.09 mm. Metapostnotum weakly extended medially <25% way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.14 mm. S6 notch shallow, less than 1/3 of disk, lateral carina absent.

Sculpture: Clypeus punctation fine and sparse (IS > 1 PD). Paraocular punctation fine and sparse (IS > 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea ovate. Foveae

slightly convergent above, posterior end 1 MOD from dorsal tangent of antennal socket. Frons finely reticulate. Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation fine and dense (IS < 1 PD). Scutellum punctation fine and dense (IS < 1 PD) finely reticulate medially. Mesopleuron punctation fine and sparse (IS = 1 PD). Lateral propodeum finely reticulate. Posterior propodeum finely reticulate. Posterior propodeum not microsculptured. Dorsal face of T1 punctation fine and dense (IS < 1 PD). T2 basal impression deep, approximately 1/4 T2 lineolate. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus yellow. Supraclypeal area yellow to within 0.5 MOD of antennal socket. Lower paraocular area yellow extending along compound eyes terminating in line with antennal socket. Labral process yellow. Mandible yellow. Scape yellow anteriorly. Flagellomeres dark. Pronotal lobe yellow. Tegula yellow. Wing veins and stigma brown, membrane light brown. Fore tibia yellow anteriorly dark posteriorly, mid tibia dark anteriorly yellow posteriorly, hind tibia with reduced dark spot on the apical anterior. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, yellow/brown. Scutellum pilosity medium-length, white. Mesopleuron pilosity medium-length, white. Sternite pubescence colour white. S3 pubescence medium length, dense. S4 pubescence medium length, dense. S5 pubescence long, medially directed apicolateral fringes.

Female:

Structure: Body length range 5.75–7.25 mm. Head broader than long (HL/HW ratio 0.8). Face below antennae convex. Labral process trapezoidal, longer than broad, apex rounded. Clypeus without median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio

1.09). Posterior ocelli 0.33 mm apart. Flagellomeres broader than long. Dorsal pronotal carina extends laterally to pronotal lobes. Prosternum not produced. ITD 1.28 mm. Metapostnotum not extended medially. Tarsi 2–4 conical. Fore tarsi width 0.061 mm.

Sculpture: Clypeus punctation coarse and sparse (IS = 1 PD). Paraocular punctation fine and sparse (IS > 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea clavate. Foveae slightly convergent above, narrow end terminating 1/2 way down antennal socket. Frons punctation fine and dense (IS < 1 PD). Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation fine and dense (IS < 1 PD). Scutellum punctation fine and dense (IS < 1 PD). Mesopleuron punctation fine and sparse (IS = 1 PD). Lateral propodeum finely reticulate. Posterior propodeum punctation fine and dense (IS < 1 PD). Posterior propodeum not microsculptured. Dorsal face of T1 punctation fine and sparse (IS > 4 PD). T2 basal impression shallow, approximately 1/4 of T2 lineolate basally. T3 punctation sparse (IS > 1 PD). T4 punctation sparse (IS > 1 PD).

Colour: Clypeus with yellow spot. Supraclypeal area occasionally with yellow spot that merges with clypeal mark. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F4-F9 yellow ventrally. Pronotal lobe yellow. Tegula light brown. Wing veins and stigma light brown, membrane hyaline. Fore and mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, yellow/brown. Scutellum pilosity medium-length, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium-length, sparse. S4 pubescence medium-length, sparse. S5 pubescence long, medially directed apicolateral fringes.

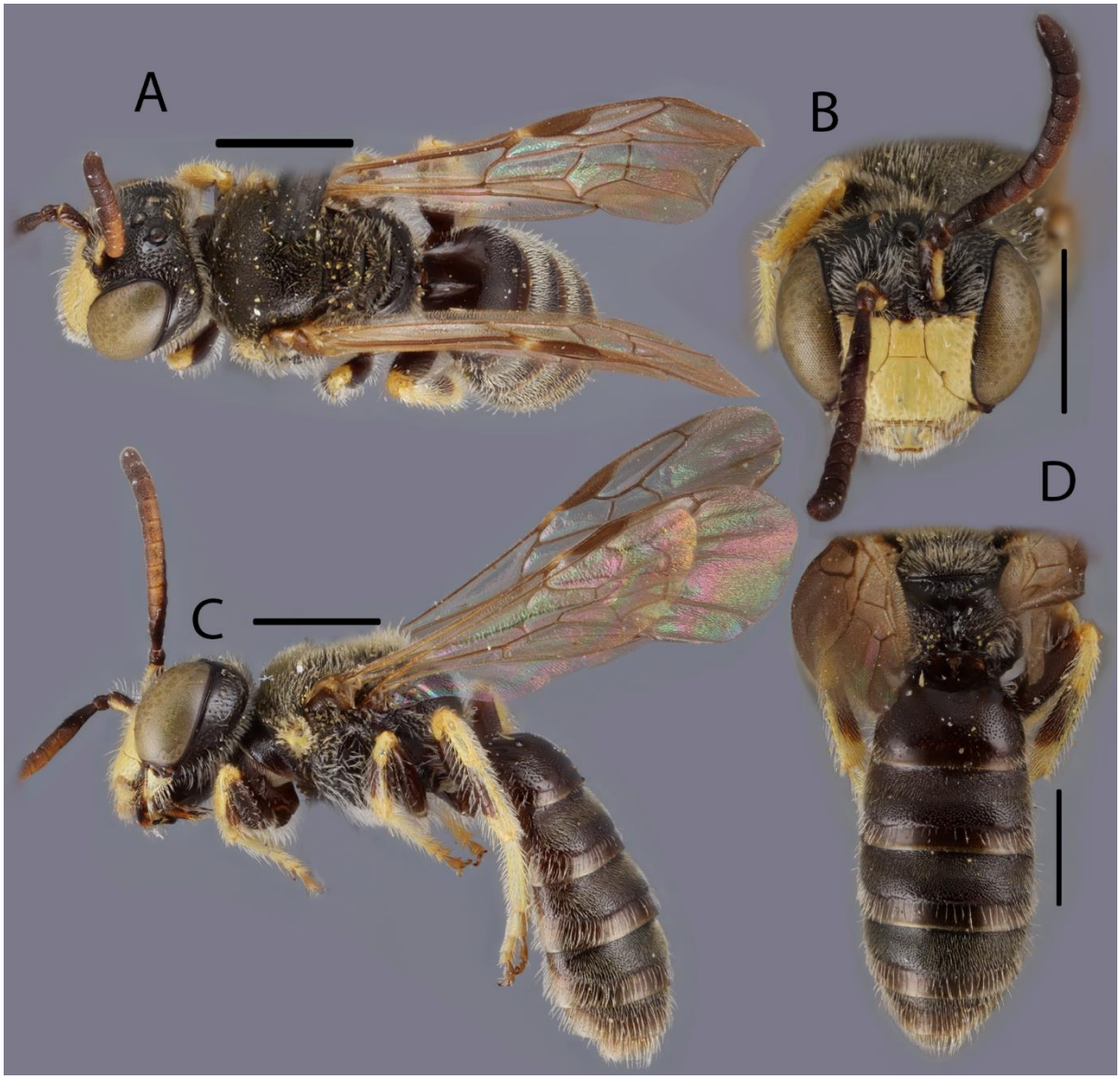


Figure 87. *Protandrena* (*Pterosarus*) *ornatipes*, ♂. CNC. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

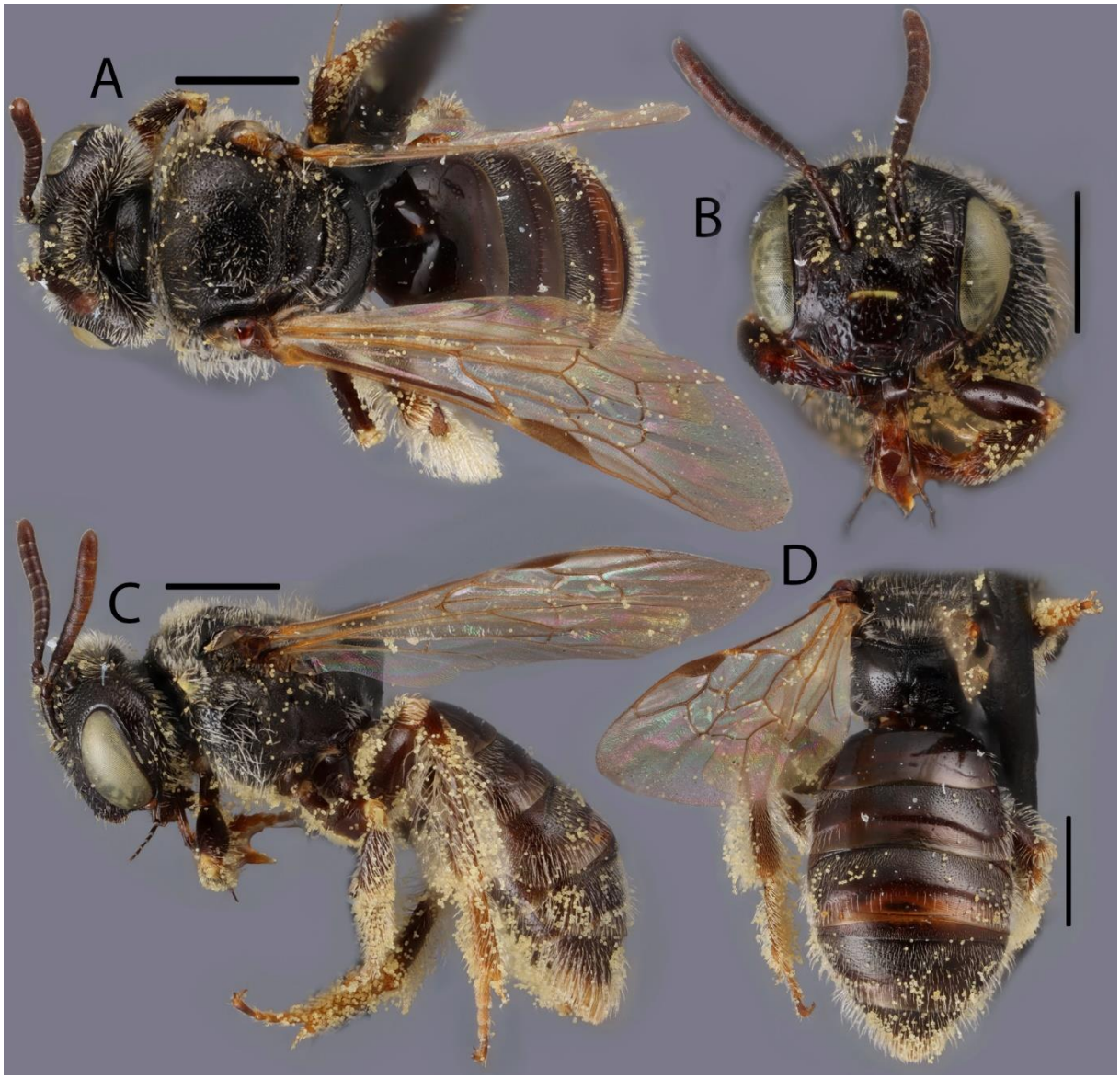


Figure 88. *Protandrena* (*Pterosarus*) *ornatipes*, ♀. SEMC_287651. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena ornatipes* has a broad flight period and is active from late March to early November. Most floral records for the species are from the tribe Astereae, with specific preference for the genus *Gutierrezia*.

Range: Mexico (Chihuahua), USA (Colorado, Kansas, Nebraska, Oklahoma, Texas, Utah).

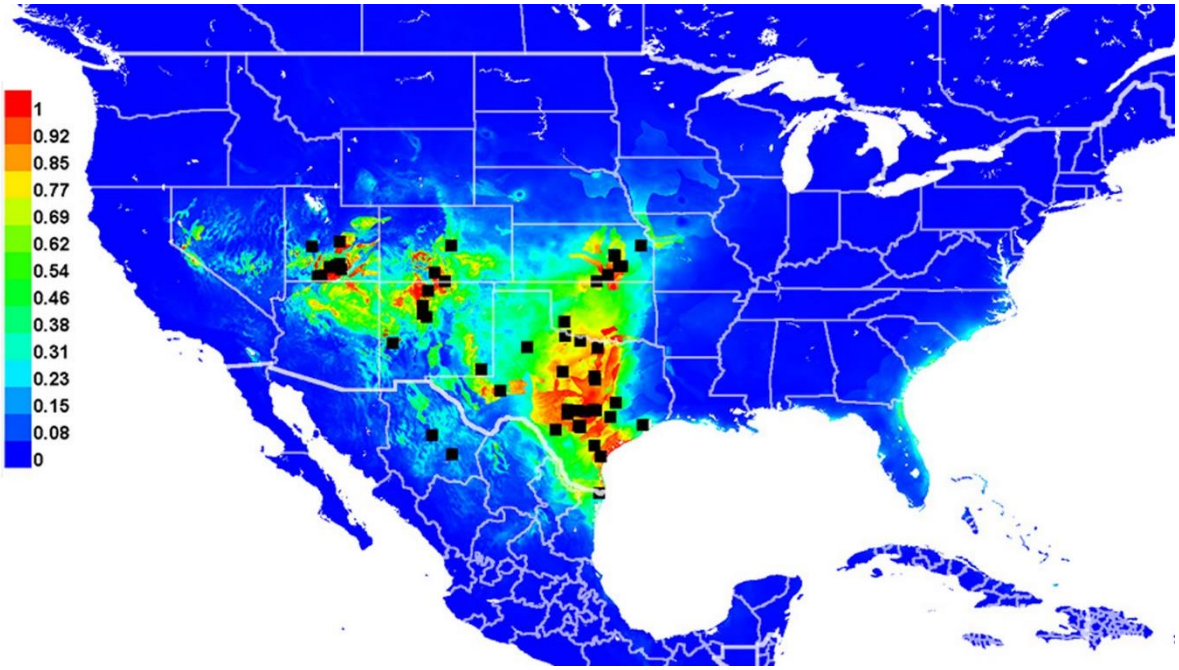


Figure 89. Georeferenced collection records of *Protandrena* (*Pterosarus*) *ornatipes* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *perlaevis* (Cockerell)**

(Figure 90, Figure 91)

Calliopsis perlaevis Cockerell, 1896b: 160. ♀. Syntypes ♀ NMNH: 533807. Type locality: USA; New Mexico: Las Cruces. 9 Oct 1896. ex. *Helianthus*. Examined by photos.

Panurginus stigmalis Swenk and Cockerell, 1907: 180. ♂♀ Syntypes ♂♀ UNL. Type locality: USA; Nebraska: Glen. 12 Aug 1906. ex. *Helianthus*. **New synonymy.** Examined by photos.

Panurginus expallidus Swenk and Cockerell, 1907: 181. ♂. Holotype ♂ UNL. Type locality: USA; Nebraska: Lincoln: 28 Aug 1900. **New synonymy.** Examined by photos.

Panurginus simulans Swenk and Cockerell, 1907: 182. ♂♀. Syntypes ♂♀ UNL: Type locality: USA; Nebraska: Nebraska City. 7 Sep 1901. ex. *Helianthus annuus.* **New synonymy.** Examined by photos.

Pseudopanurgus (*Pseudopanurgus*) *helianthi* Mitchell, 1960: 267. ♀. Holotype ♀ PERC: 0062732. Type locality: USA; Indiana: Tippecanoe: 21 Aug 1955. **New synonymy.** Examined by photos.

Taxonomy: Cockerell, 1922: 5, comparative notes with *piercei*, 9–10,key to species; Stevens, 1950: 93,redescription as *simulans*; Timberlake 1967: 20, 22, key to species.

Type specimens: Cockerell (1896b) described *Calliopsis perlaevis* from two female syntypes. I select specimen 533807 at the NMNH as the lectotype. Swenk and Cockerell (1907) described *Panurginus stigmalis* from two male and two female specimens. One male and one female are referred to as the types, but neither specimen was designated as the sole name-bearing type, so we consider the type series to be syntypes. Swenk and Cockerell (1907) designated a single type for *Panurginus expallidus*. There is no indication that other specimens were examined. Swenk and Cockerell (1907) described *Panurginus simulans* from seven females and one male. While Swenk and Cockerell (1907) indicated a male and female pair are the "types" calling other examined specimens paratypes, neither of the "type specimens" was designated as the name-bearing type. As such all eight specimens are considered syntypes. Mitchell (1960) described *Pseudopanurgus* (*Pseudopanurgus*) *helianthi* from females. The number of specimens was not indicated. The type is a holotype female by original designation.

Diagnosis:

Males of *Pr*. (*Pt*.) *perlaevis* can be recognized by a combination of their non-macrosculptured posterior face of propodeum (contrast all except: *Pr. barberi, Pr. bidentis, Pr. illustris, Pr. irregularis, Pr. labrosa*), yellow pronotal lobes (contrast *Pr. bidentis, Pr. illustris, Pr. irregularis*), and uniformly fine and dense scutum punctures (contrast remaining).

Females of *Pr*. (*Pt*.) *perlaevis* can be recognized by a combination of their non-macrosculptured posterior face of propodeum (contrast all except: *Pr. albertensis, Pr. amor, Pr. andrenoides, Pr. barberi, Pr. bidentis, Pr. dracomons, Pr. illustris, Pr. irregularis, Pr. labrosa, Pr. piercei*), uniformly fine and sparse scutum punctures (contrast *Pr. albertensis, Pr. amor, Pr. andrenoides, Pr. barberi, Pr. bidentis, Pr. irregularis, Pr. labrosa*), minutely and very sparsely punctate T1 (IS > 10 PD) (contrast *Pr. dracomons, Pr. piercei*), and no impressed line on clypeus (contrast *Pr. illustris*).

Material examined:

CANADA – **Alberta** • 2♀♀; Taber; [49.8283° N, 112.2692° W]; elev. 809 m.; 18 Aug. 2011; Zink L. leg.; UCMZ • 1♀; Taber; [49.8447° N, 111.7197° W]; elev. 809 m.; 23 Aug. 2011; Zink L. leg.; UCMZ • 1♀; Claresholm; [50.1109° N, 113.4251° W]; elev. 969 m.; 25 Jul. 2017; Gavin M. leg.; UCMZ • 1♀; Hays; [50.1649° N, 111.9608° W]; elev. 769 m.; 15 Jul. 2016; Johnson S. leg.; UCMZ – **Manitoba** • 1♀; Division 2, Gardenton; 49.074° N, 96.709° W; 28 Aug. 2019; Shukla-Bergen S. leg.; ex *Helianthus pauciflorus*; WRME • 1♂; Division 2, Linden; 49.679° N, 96.895° W; 09 Aug. 2019; Shukla-Bergen S. leg.; WRME • 1♀; Division 2, Ridgeville; 49.119° N, 97.011° W; 22 Aug. 2019; Shukla-Bergen S. leg.; ex *Helianthus pauciflorus*; WRME • 1♂; Division 2, Senkiw; 49.238° N, 96.917° W; 29 Jul. 2019; Hanuschuk E. leg.; WRME • 3♀♀; Division 3, Altona; [49.1° N, 97.5667° W]; 27 Aug. 1953; Barrett C.F. leg.; ex *Helianthus* sp.;

WRME • 2♀♀, 1♂; same location as preceding; 28 Aug. 1953; Barrett C.F. leg.; ex *Helianthus* sp.; WRME • 1♀; same location as preceding; 26 Aug. 1953; Barrett C.F. leg.; ex *Helianthus* sp.; WRME • 2♀♀; same location as preceding; 21 Aug. 1953; Barrett C.F. leg.; ex *Helianthus* sp.; WRME • 34♀♀, 2♂♂; same location as preceding; 10 Aug. 1951; Askew W.L. leg.; ex *Helianthus* sp.; WRME • 1♀; Division 3, Winkler ; [49.1833° N, 97.9333° W]; 05 Sep. 1950; Barrett C.F. leg.; WRME • 2♀♀; Division 7, Assiniboine Corridor WMA; 49.593° N, 99.346° W; 28 Aug. 2019; Hanuschuk E. leg.; WRME • 1♀; Division 7, Spruce Woodlands Provincial Park; 49.6802° N, 99.1475° W; 02 Jul. 2018; Gibbs J. leg.; WRME • 1♀; Division 7, Spruce Woods; 49.73° N, 99.294° W; 20 Jul. 2018; Hanuschuk E. leg.; WRME • 1♀; Division 7, Yellow Quill Prarie Preserve; 49.6808° N, 99.5566° W; 03 Aug. 2005; Patenaude A.M. leg.; WRME • 1♀; Virden (19.6 km WSW); [49.8014° N, 101.1961° W]; 13 Aug. 2021; Abel O. leg.; CMN • 1♀; 19 Aug. 2010; Wareham K., Patterson S. leg.; WRME – **Saskatchewan** • 4♀♀; Division 2, Bengough; 49.2899° N, 105.1141° W; 07 Jul. 2013; Heisler L., Gallon A. leg.; RSKM • 1♀; Division 4, Grasslands National Park; 49.1792° N, 107.3907° W; 28 Jul. 1996; Finnamore A.T. leg.; PMAE

USA – **Colorado** • 1♂; Kit Carson, Hinkhouse2; 39.4156° N, 102.1685° W; elev. 3993 m.; 22 Aug. 2014; UCMC • 2♂♂; Logan, Bauden; 40.5211° N, 102.972° W; elev. 1348 m.; 28 Jun. 2013; UCMC • 11♀♀, 3♂♂; same location as preceding; 21 Aug. 2013; UCMC • 2♂♂; Logan, MERTENS; 40.5349° N, 103.4758° W; elev. 1328 m.; 22 Aug. 2014; UCMC • 1♀, 1♂; same location as preceding; 01 Aug. 2014; UCMC • 1♀; Mesa, Grand Junction; 39.0876° N, 108.4566° W; 03 Sep. 1999; Walters R., Walters J. leg.; UCMC • 6♀♀, 1♂; Phillips, Ham4; 40.5621° N, 102.4776° W; elev. 1192 m.; 23 Aug. 2013; UCMC • 11♀♀, 6♂♂; Washington, CRONK; 39.7722° N, 103.4595° W; elev. 1469 m.; 21 Aug. 2014; UCMC • 1♂; Washington,

Ernst; 39.7628° N, 103.0836° W; elev. 1431 m.; 22 Aug. 2013; UCMC • 1♀; Washington, Leach; 39.8734° N, 103.4244° W; elev. 1432 m.; 22 Aug. 2014; UCMC • 1♂; Washington; 39.8284° N, 103.3835° W; elev. 1460 m.; 22 Aug. 2014; Wright K. leg.; UCMC • 2♀♀; Yuma, Wray; 40° N, 102.1° W; elev. 1128 m.; 17 Aug. 1919; SEMC – **Illinois** • 1♀; Champaign, Urbana; [40.1106° N, 88.2073° W]; 27 Sep. 1938; Balduf W.V. leg.; INHS • 1♀; Champaign, Urbana, University of Illinois Woods; 40.1106° N, 88.2072° W; 06 Sep. 1891; INHS • 1♀; same location as preceding; 29 Sep. 1938; Balduf W.V. leg.; INHS • 1♀; same location as preceding; 06 Sep. 1891; Robertson C. leg.; INHS • 1♀; Macoupin, Carlinville; 39.2797° N, 89.8817° W; 13 Aug. 1897; Robertson C. leg.; INHS • 1♀; Macoupin, Carlinville; [39.2798° N, 89.8818° W]; 13 Aug. 1897; Robertson C. leg.; INHS • 1♂; same location as preceding; 31 Aug. 1971; Marlin J.C. leg.; ex *Helianthus grosseserratus*; INHS • 1♂; INHS • 1♂; same location as preceding; INHS – **Indiana** • 1♀; Tippecanoe; [40.3883° N, 87.1751° W]; 25 Aug. 1955; ex *Helianthus annuus*; PERC • 1♂; Vermilion, Smith Cemetery, Cayuga on SR 63 (5 mi N); [40.026° N, 87.451° W]; 28 Aug. 2005; Jean R.P. leg.; ex *Silphium* terbinthinaceum; RJPC • 1♂; same location as preceding; 28 Aug. 2005; Jean R.P. leg.; ex *Helianthus divaricatus*; RJPC – **Iowa** • 1♂; Woodbury/Plymouth, Sioux City; [42.5° N, 96.4003° W]; 19 Aug. 1932; Mickel C.E. leg.; UMSP – **Kansas** • 1♂; Douglas, Lawrence; [38.9717° N, 95.2353° W]; 23 Aug. 1969; Matuza G.A. leg.; CUIC • 1♀; same location as preceding; Aug. 1986; Danforth B.N. leg.; SEMC • 1♀; Douglas, Lawrence (6 mi NW); [38.9987° N, 95.3616° W]; 15 Sep. 1979; Michener C.D. leg.; ex *Helianthus* tuberosus; SEMC • 1♀; Pawnee, Larned; [38.1806° N, 99.0987° W]; 09 Sep. 1949; Michener C.D., Beamer leg.; ex *Helianthus annuus*; SEMC • 1♂; Russel, Wilson Lake; [38.9426° N, 98.5117° W]; 24 Aug. 1989; Eickwort G.C. leg.; CUIC • 3♂♂; Thomas; [39.3667° N, 101.3768° W]; 20 Aug. 1989; Eickwort G.C. leg.; CUIC – **Minnesota** • 1♂; Clay, Magnusson

WMA; 46.7848° N, 96.4184° W; 02 Aug. 2018; Drons D. leg.; MNDNR • 1♂; Ramsey, Stryker Avenue Community Garden; 44.9273° N, 93.0883° W; 07 Aug. 2014; Burington J. leg.; MNDNR • 1♀; Yellow Medicine, Sioux Nation WMA; [44.6791° N, 96.44° W]; 12 Aug. 2015; Fulton A leg.; MNDNR – **Nebraska** • 1♂; Dundy, Bankelman; [40.1306° N, 101.6158° W]; 17 Aug.; Cockerell T.D.A. leg.; ex *Helianthus* lenticularis; UCMC • 1♂; Lancaster, Lincoln; [40.8° N, 96.667° W]; 27 Aug. 1900; Bruner L. leg.; UNSM • 1♂; Sioux, Glen; [42.6075° N, 103.5838° W]; elev. 1829 m.; 12 Aug. 1906; Smith H.S. leg.; UNSM • 1♂; 01 Sep. 1901; Carriker M.A. leg.; ex *Helianthus annuus*; UNSM – **New Mexico** • 1♂; Bernalillo, Albuquerque; [35.0844° N, 106.6504° W]; 01 Sep. 1935; Michener C.D. leg.; ex *Helianthus* sp.; SEMC • 1♀; Dona Ana, Las Cruces; 32.3122° N, 106.7778° W; elev. 1222 m.; 06 Oct. 1895; Cockerell T.D.A. leg.; ex *Helianthus*; UCMC • 2♀♀; same location as preceding; 21 Sep. 1895; Cockerell T.D.A. leg.; ex *Helianthus annuus*; UCMC • 1♀; Dona Ana, Las Cruces; [32.3123° N, 106.7783° W]; 06 Oct. 1895; Cockerell T.D.A. leg.; ex *Helianthus* sp.; USNM – **North Dakota** • 1♀; Barnes, NE of Rogers; 47.0959° N, 98.1509° W; 03 Aug. 2010; Evans E. leg.; MNDNR • 1♀; same location as preceding; 03 Aug. 2010; Evans E. leg.; ex *Helianthus pauciflorus*; MNDNR • 4♂♂; Barnes, Rogers (13.5 km E); 47.1102° N, 97.077° W; 03 Aug. 2010; Evans E. leg.; MNDNR • 1♀; Barnes, Rogers (15 km E); 47.0953° N, 98.041° W; 03 Aug. 2010; Evans E. leg.; MNDNR • 1♀; Barnes, Rogers (6.4 km NE); 47.0815° N, 97.1718° W; 15 Aug. 2010; Evans E. leg.; MNDNR • 1♀; same location as preceding; 03 Aug. 2010; Evans E. leg.; MNDNR • 1♀; Barnes, Sanborn (9 km NW); 46.9797° N, 98.291° W; 03 Aug. 2010; Evans E. leg.; MNDNR • 1♀; Cass, Fargo; [46.8772° N, 96.7898° W]; 20 Aug. 1924; Stevens O.A. leg.; ex *Agoseris glauca*; AMNH • 1♂; same location as preceding; 26 Jul. 1911; Stevens O.A. leg.; ex *Helianthus maximiliani*; AMNH • 2♂♂; same location as preceding; 08 Aug. 1912; Stevens O.A. leg.; ex *Helianthus maximiliani*;

AMNH • 2♀♀, 1♂; same location as preceding; 20 Aug. 1917; Stevens O.A. leg.; ex *Helianthus maximiliani*; AMNH • 2♀♀; same location as preceding; 18 Aug. 1912; Stevens O.A. leg.; ex *Helianthus maximiliani*; AMNH • 1♀; same location as preceding; 02 Sep. 1913; Stevens O.A. leg.; ex *Helianthus annuus*; AMNH • 1♀; same location as preceding; 13 Aug. 1911; Stevens O.A. leg.; ex *Helianthus annuus*; AMNH • 1♀; same location as preceding; 10 Aug. 1912; Stevens O.A. leg.; ex *Helianthus maximiliani*; AMNH • 1♂; same location as preceding; 15 Aug. 1915; Stevens O.A. leg.; ex *Helianthus petiolaris*; AMNH • 1♀; Cass; [46.9295° N, 97.2203° W]; 20 Aug. 1983; Sammataro D. leg.; INHS • 2♀♀; Cass; 20 Aug. 1982; Sammataro D. leg.; WIRC • 1♂; Griggs, Walum (11 km E); 47.2697° N, 98.0447° W; 15 Aug. 2010; Evans E. leg.; MNDNR • 1♂; same location as preceding; 03 Aug. 2010; Evans E. leg.; MNDNR • 1♀; same location as preceding; 11 Sep. 2010; Evans E. leg.; MNDNR • 1♂; Stark, Dickinson; [46.8792° N, 102.7896° W]; 28 Jul. 1912; Stevens O.A. leg.; ex *Helianthus petiolaris*; AMNH • 1♂; Stutsman, Pingree (11 km NW); 47.1835° N, 98.8203° W; 03 Aug. 2010; Evans E. leg.; MNDNR • 1♂; same location as preceding; 15 Aug. 2010; Evans E. leg.; ex *Helianthus pauciflorus*; MNDNR • 1♀; same location as preceding; 15 Aug. 2010; Evans E. leg.; MNDNR • 2♂♂; Stutsman, Pingree (12.4 km NW); 47.2005° N, 98.8062° W; 15 Aug. 2010; Evans E. leg.; MNDNR • 1♂; same location as preceding; 03 Aug. 2010; Evans E. leg.; MNDNR • 2♂♂; Stutsman, Pingree (6.8 km NE); 47.1948° N, 98.8056° W; 10 Aug. 2011; Evans E. leg.; MNDNR • 1♂; Stutsman, Pingree (7.3 km N); 47.2258° N, 98.9096° W; 03 Aug. 2010; Evans E. leg.; MNDNR • 2♂♂; Stutsman, Pingree (8.7 km NW); 47.1816° N, 98.7945° W; 10 Aug. 2011; Evans E. leg.; MNDNR • 1♀; Towner, Perth; [48.7164° N, 99.4579° W]; 20 Aug. 1913; Stevens O.A. leg.; ex *Grindelia squarrosa*; AMNH • 1♀, 3♂♂; Williams, Williston; [48.147° N, 103.618° W]; 15 Aug. 1915; Stevens O.A. leg.; ex *Helianthus petiolaris*; AMNH • 1♀; 46.88°

N, 97.23° W; 14 Aug. 2019; Ferguson B. leg.; USDA ND • 1♀; same location as preceding; 16 Aug. 2019; Ferguson B. leg.; USDA ND • 1♀; same location as preceding; 17 Aug. 2019; Ferguson B. leg.; USDA ND – **South Dakota** • 4♂♂; Washbaugh, Long Valley; [43.4617° N, 101.4949° W]; 11 Aug. 1978; Michener C.D. leg.; ex *Helianthus annuus*; SEMC – **Texas** • 1♀; Brewster, Big Bend National Park, Chisos Mountains; [29.27° N, 103.3° W]; 28 Oct. 1991; Sugden E.A. leg.; BBSL – **Utah** • 1♂; Iron, Beaver (11 mi S); [38.1143° N, 112.6444° W]; 30 Jul. 1973; Eickwort G.C. leg.; CUIC – **Wyoming** • 1♀; Big Horn, Greybull; [44.4891° N, 108.0562° W]; 23 Aug. 1955; Fronk W.D. leg.; ESUW

Description

Male:

Structure: Body length range 6.33–7.43 mm. Head longer than broad (HL/HW ratio 0.97). Face below antennae convex. Labral process narrowly trapezoidal, longer than broad, apex truncate. Clypeus without median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.08). Posterior ocelli 0.36 mm apart. Flagellomeres about equal in length and width. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.4 mm. Metapostnotum not extended medially. Tarsi 2–4 triangular. Fore tarsi width 0.13 mm. S6 notch deep, extending approximately 1/2 of disk, lateral carina absent.

Sculpture: Clypeus punctation fine and dense (IS < 1 PD). Paraocular punctation fine and dense (IS < 1 PD). Supraclypeal area punctation fine and dense (IS < 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 0.5 MOD from dorsal tangent of antennal socket. Frons finely reticulate. Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation fine and dense (IS < 1 PD). Scutellum punctation fine and dense laterally (IS < 1 PD) finely

reticulate medially. Mesopleuron punctation coarse and sparse posteriorly (IS = 1 PD) denser anteriorly (IS < 1 PD). Lateral propodeum coarsely reticulate. Posterior propodeum punctation absent. Posterior propodeum tessellate. Dorsal face of T1 punctation fine and sparse (IS > 4 PD). T2 basal impression deep, approximately 1/3 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation sparse (IS > 1 PD).

Colour: Clypeus yellow. Supraclypeal area occasionally with reduced spot. Lower paraocular area yellow reaching margin of clypeus medially extending along compound eye terminating in line with ventral tangent of antennal socket. Labral process yellow. Mandible yellow. Scape yellow anteriorly. Flagellomeres F1-F10 yellow ventrally. Pronotal lobe yellow. Tegula yellow. Wing veins and stigma pale, membrane hyaline. Fore tibia yellow anteriorly dark posteriorly, mid tibia yellow basally and apically dark medially, hind tibia with reduced dark spot. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity long, white. Mesopleuron pilosity medium-length, white. Sternite pubescence colour yellow. S3 pubescence medium-length, dense. S4 pubescence medium-length, dense. S5 pubescence long, medially directed apicolateral fringes.

Female:

Structure: Body length range 6.75–8.5 mm. Head longer than broad (HL/HW ratio 0.93). Face below antennae convex. Labral process U shaped, broader than long, apex rounded. Clypeus without median impressed line. Compound eyes parallel (UOD/LOD ratio 0.96). Posterior ocelli 0.39 mm apart. Flagellomeres broader than long. Dorsal pronotal carina absent. Prosternum not

produced. ITD 1.63 mm. Metapostnotum not extended medially. Tarsi 2–4 conical. Fore tarsi width 0.08 mm.

Sculpture: Clypeus punctation coarse and dense (IS < 1 PD). Paraocular punctation coarse and dense (IS < 1 PD). Supraclypeal area punctation coarse and dense (IS < 1 PD). Fovea clavate. Foveae converging above, narrow end terminating in line with ventral tangent of antennal socket. Frons punctation fine and dense (IS < 1 PD). Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation fine and sparse (IS > 1 PD). Scutellum punctation fine and sparse laterally (IS > 1 PD) denser medially (IS < 1 PD). Mesopleuron punctation fine and sparse posteriorly (IS = 1 PD) coarse and dense anteriorly (IS < 1 PD). Lateral propodeum punctation fine and dense (IS < 1 PD). Posterior propodeum punctation absent. Posterior propodeum not microsculptured. Dorsal face of T1 punctation very minute and sparse (IS > 10 PD). T2 basal impression absent, approximately 1/4 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation absent.

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F3-F8 yellow ventrally. Pronotal lobe black. Tegula light brown. Wing veins and stigma pale, membrane hyaline. Fore and mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, yellow. Scutellum pilosity medium-length, yellow. Mesopleuron pilosity long, yellow. Sternite pubescence colour yellow. S3 pubescence medium-length, sparse. S4 pubescence medium-length, sparse. S5 pubescence long, medially directed apicolateral fringes.

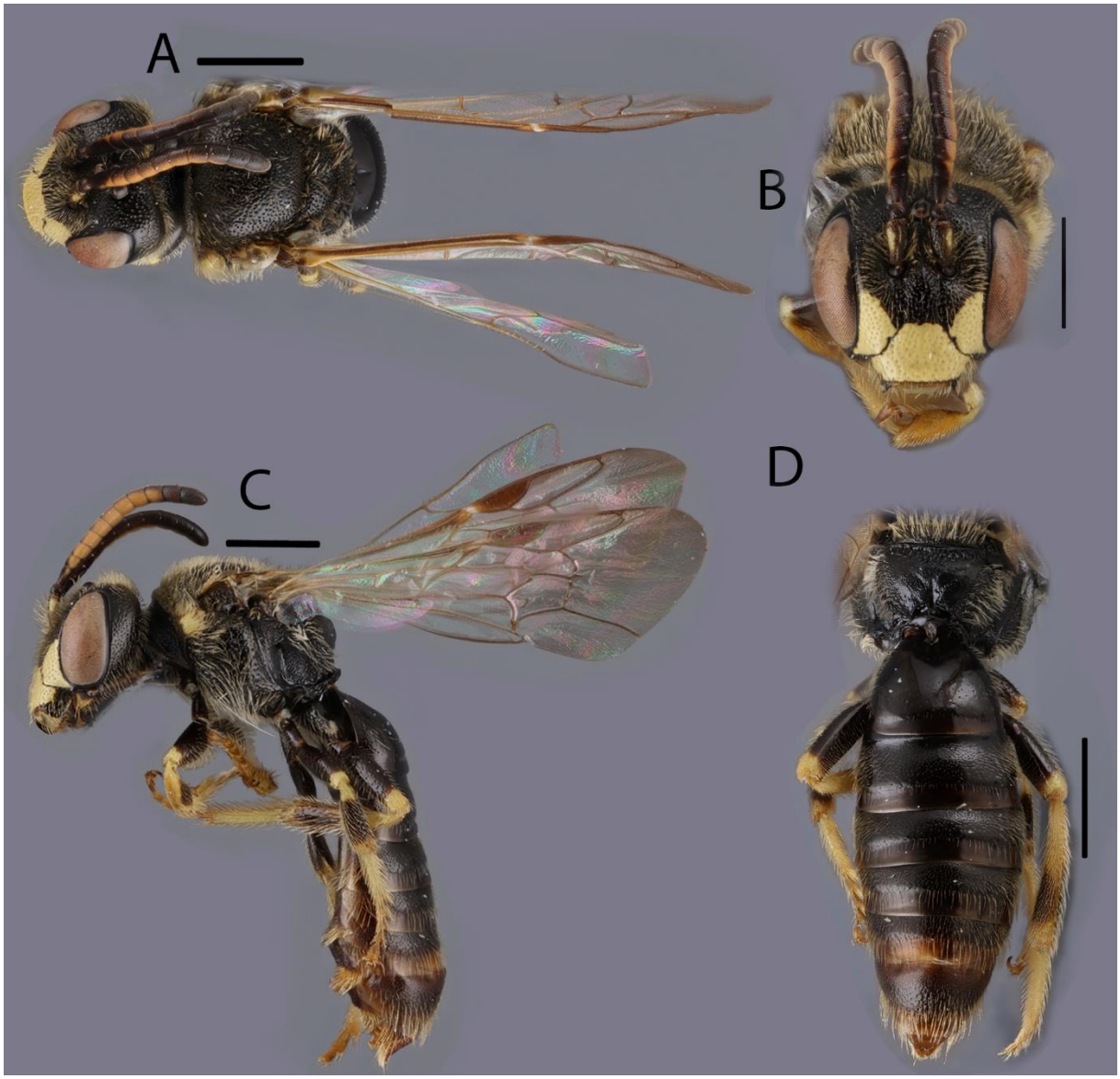


Figure 90. *Protandrena* (*Pterosarus*) *perlaevis*, ♂. MNDNR. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

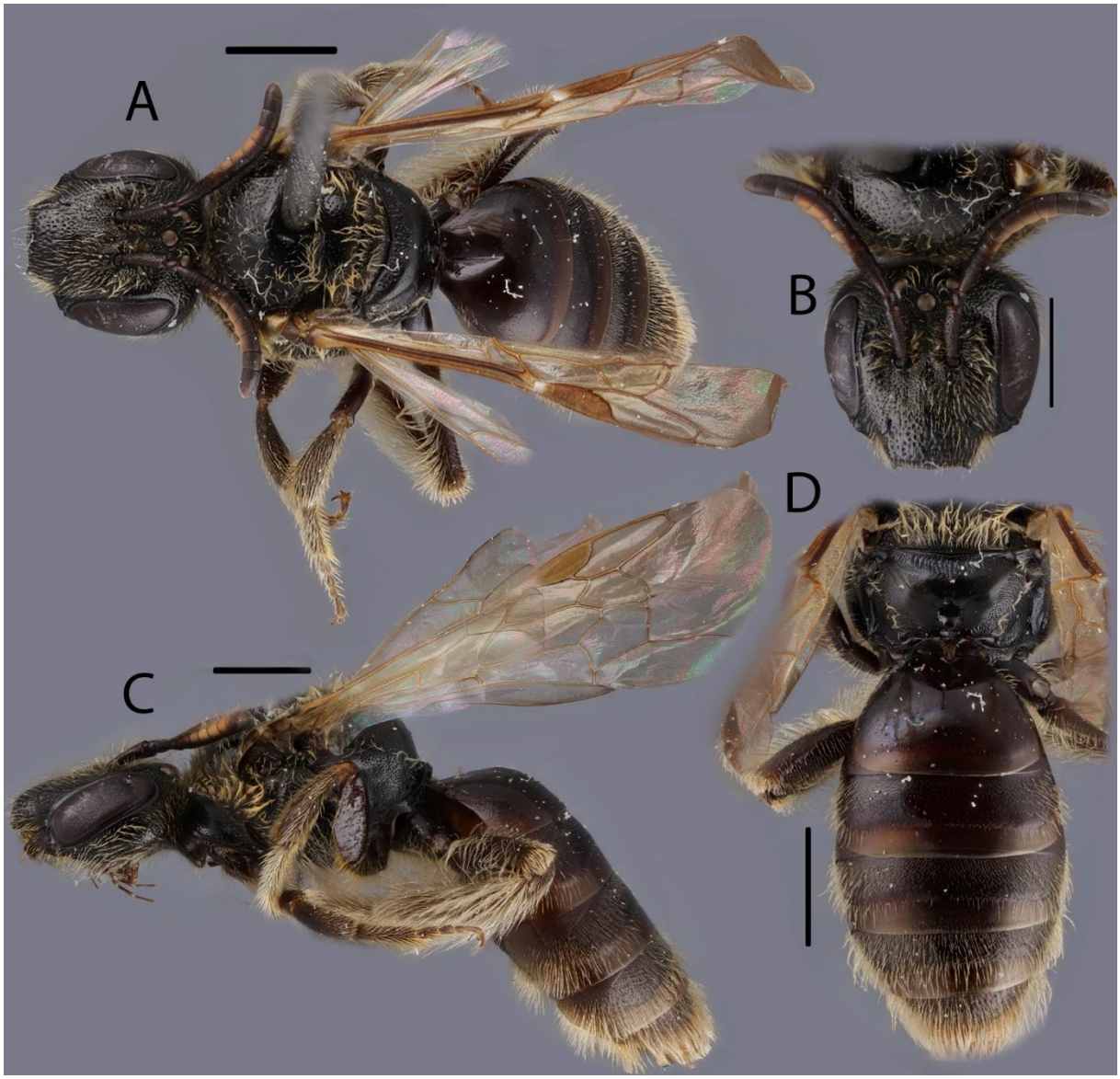


Figure 91. *Protandrena* (*Pterosarus*) *perlaevis*, ♀. MNDNR. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological Notes: *Protandrena perlaevis* is active from late June to late September. Hurd and Linsley (1972) recorded *Holcopasites insoletus* (Linsley 1942) as the parasite of *Protandrena perlaevis*. Most floral records for the species are in the tribe Heliantheae with specific preference for the genus *Helianthus*.

Range: Canada (Alberta, Manitoba, Saskatchewan), USA (Colorado, Illinois, Indiana, Kansas, Nebraska, New Mexico, North Dakota, Minnesota, South Dakota, Utah, Wyoming).

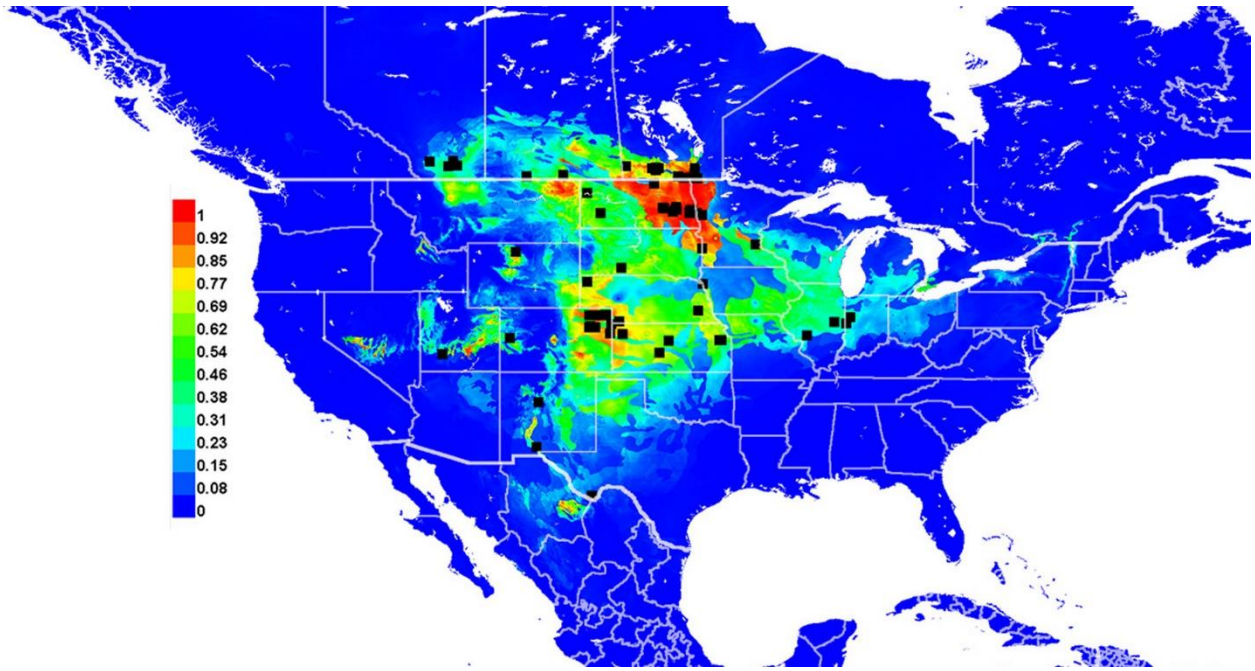


Figure 92. Georeferenced collection records of *Protandrena* (*Pterosarus*) *perlaevis* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *piercei* (Crawford)**

(Figure 93, Figure 94)

Panurginus Piercei Crawford, 1903: 335. ♂♀. Syntypes ♂♀ NMNH: 533812. Type locality: USA; Nebraska: Lincoln. 7 Sep 1903. Examined by photos.

Panurginus horizontalis Swenk and Cockerell, 1907: 183. ♂. Type ♂ UNL. Type locality: USA; Nebraska: Glen. 21 Aug 1906. **New synonymy.** Examined by photos.

Taxonomy: Stevens, 1950: 93. (Additional Description).

Type specimens: Crawford (1903) described *Panurginus piercei* from one male and female taken from a nest, and six additional females. I select specimen 533812 at the NMNH as the lectotype. Swenk and Cockerell (1907) described *Panurginus horizontalis* from males. The number of specimens was not indicated. The type is a holotype male by original designation.

Diagnosis:

Males of *Pr*. (*Pt*.) *piercei* can be recognized by a combination of their fine and dense scutum punctures (IS < 1 PD) (contrast all except*: albipes aurifodinae bilobata ornatipes perlaevis planafacialis quadrapylae vigvierae*), rugose posterior face of propodeum (contrast *albipes aurifodinae bilobata ornatipes perlaevis planafacialis quadrapylae*) and flattened face (contrast *vigvierae*)

Females of *Pr*. (*Pt*.) *piercei* can be recognized by a combination of their conically produced prosternum (contrast all except *lutzae rudbeckiae ehnesae*) and large size (> 7 mm) (contrast remaining).

Material examined:

CANADA – **Alberta** • 1♀; Division 1, Medicine Hat; [50.0333° N, 110.6833° W]; 20 Aug. 1916; Sladen F.W.L. leg.; CNC • 1♂; same location as preceding; 23 Aug. 1919; Sladen F.W.L. leg.; CNC • 5♂♂; Taber; [49.8447° N, 111.7197° W]; elev. 809 m.; 23 Aug. 2011; Zink L. leg.; UCMZ– **Manitoba** • 1♀; Coldwell, Coldwell; [50.5546° N, 97.9749° W]; WRME • 1♀; Division 3, Altona; [49.1° N, 97.5667° W]; 10 Aug. 1951; Askew W.L. leg.; ex *Helianthus* sp.; CNC – **Saskatchewan** • 1♀; Division 6, Holdfast; [50.963° N, 105.405° W]; 07 Aug. 1925;

King K.M. leg.; CNC • 1♂; Great Sand Hills (NW); 50.6834° N, 109.2901° W; 06 Aug. 2019; Onuferko T.M. leg.; TOPC

USA – Colorado • 1♀; Adams, Aurora; [39.7294° N, 104.8319° W]; 23 Aug. 1989; Eickwort G.C. leg.; CUIC • 1♀; Boulder, Gunbarrel; 40.066° N, 105.171° W; elev. 1613 m.; 22 Aug. 1981; Robinson P. leg.; ex *Helianthus* sp.; UCMC • 1♀; same location as preceding; 20 Aug. 1981; Robinson P. leg.; ex *Helianthus* sp.; UCMC • 2♂♂; Boulder; 40.094° N, 105.347° W; 11 Aug. 1925; Hicks C.H. leg.; UCMC • 1♀; same location as preceding; 13 Aug. 1925; Hicks C.H. leg.; UCMC • 1♀; same location as preceding; 07 Aug. 1925; Hicks C.H. leg.; UCMC • 1♀; Boulder; 40.01499° N, 105.27055° W; elev. 1667 m.; Cockerell T.D.A. leg.; ex *Helianthus* sp.; UCMC • 1♂; El Paso, Colorado Springs; [38.8339° N, 104.8214° W]; elev. 1803 m.; Tucker E.S. leg.; CUIC – **Minnesota** • 1♂; Polk; [47.7598° N, 96.6278° W]; 29 Jul. 1936; Denning D.G. leg.; UMSP – **Montana** • 2♀♀; Daniels, Four Buttes (7 mi. NE); 48.8806° N, 105.4964° W; elev. 689 m.; 31 Jul. 2020; Pritchard Z.A., Botti J. leg.; MTEC • 1♀; Gallatin, Westscape Nursery, 110 Progressive drive; [45.7776° N, 111.1155° W]; 02 Sep. 2010; Delphia C.M. leg.; MTEC – **Nebraska** • 1♂; Lancaster, Lincoln; 40.8146° N, 96.6886° W; elev. 366 m.; Aug.; Swenk leg.; UCMC • 1♂; Lancaster, Lincoln; [40.8° N, 96.667° W]; 07 Sep. 1903; Pierce W.D. leg.; USNM • 1♂; Sioux, Glen; [42.6075° N, 103.5838° W]; elev. 1219 m.; 21 Aug. 1906; Jones P.R. leg.; UNSM– **New Mexico** • 1♀; Colfax, Raton; [36.9034° N, 104.4392° W]; elev. 2042 m.; Aug.; Cockerell T.D.A. leg.; UCMC – **North Dakota** • 1♀; Barnes, Rogers (3.3 km NNE); 47.1031° N, 98.1933° W; 12 Aug. 2011; Evans E. leg.; MNDNR • 1♂; Cass, Fargo; [46.8772° N, 96.7898° W]; 16 Aug. 1965; LaBerge W.E. leg.; SEMC • 1♂; same location as preceding; 12 Aug. 1917; Stevens O.A. leg.; ex *Grindelia squarrosa*; AMNH • 1♀; same location as preceding; 13 Aug. 1911; Stevens O.A. leg.; ex *Helianthus annuus*; AMNH • 1♀; same location as

preceding; 15 Sep. 1913; Stevens O.A. leg.; ex *Taraxacum officinale*; AMNH • 1♀; Cass, Gardner; [47.1444° N, 96.9773° W]; 16 Aug. 1965; LaBerge W.E. leg.; ex *Helianthus maximiliani*; SEMC • 1♂; Cavalier, Wales; [48.8958° N, 98.6026° W]; 08 Aug. 1913; Stevens O.A. leg.; ex *Grindelia squarrosa*; AMNH • 1♂; same location as preceding; 08 Aug. 1913; Stevens O.A. leg.; SEMC • 1♀, 1♂♂; same location as preceding; 08 Aug. 1913; Stevens O.A. leg.; ex *Grindelia squarrosa*; CUIC • 1♀, 1♂♂; same location as preceding; 08 Aug. 1913; Stevens O.A. leg.; ex *Grindelia squarrosa*; UKIC • 1♀; Griggs, Karnak (3.6 km SW); 47.2554° N, 98.0337° W; 14 Aug. 2012; Evans E. leg.; MNDNR • 1♂; Hettinger, Mott; [46.3725° N, 102.3271° W]; 20 Aug. 1914; Stevens O.A. leg.; ex *Solidago rigida*; AMNH • 1♀; same location as preceding; 20 Aug. 1914; Stevens O.A. leg.; ex *Helianthus maximiliani*; AMNH • 1♂; LaMoure, Edgeley; [46.3591° N, 98.7157° W]; 27 Aug. 1921; Stevens O.A. leg.; ex *Helianthus maximiliani*; AMNH • 1♂; Nelson, Lakota; [48.0428° N, 98.3362° W]; 23 Aug. 1913; Stevens O.A. leg.; ex *Grindelia squarrosa*; AMNH • 1♀; Stark, Dickinson; [46.8792° N, 102.7896° W]; 25 Aug. 1912; Stevens O.A. leg.; ex *Helianthus petiolaris*; AMNH • 1♀; Stutsman, Edmunds (2.4 km E); 47.2523° N, 98.933° W; 14 Aug. 2012; Evans E. leg.; MNDNR • 1♂; Towner, Perth; [48.7164° N, 99.4579° W]; 20 Aug. 1913; Stevens O.A. leg.; ex *Grindelia squarrosa*; AMNH

Description

Male:

Structure: Body length range 7.3–8.5 mm. Head broader than long (HL/HW ratio 0.91). Face below antennae flat. Labral process narrowly trapezoidal, longer than broad, apex emarginate. Clypeus with median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.25). Posterior ocelli 0.37 mm apart. Flagellomeres about equal in length and width.

Dorsal pronotal carina absent. Prosternum not produced. ITD 1.45 mm. Metapostnotum weakly extended medially <25% way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.18 mm. S6 notch deep, extending approximately 1/2 of disk, lateral carina absent.

Sculpture: Clypeus punctation fine and dense (IS < 1 PD). Paraocular punctation fine and dense (IS < 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea clavate. Foveae converging above, narrow end terminating in line with dorsal tangent of antennal socket. Frons coarsely reticulate. Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation fine and dense (IS < 1 PD). Scutellum punctation fine and dense (IS < 1 PD). Mesopleuron punctation fine and dense (IS < 1 PD). Lateral propodeum punctation rugose. Posterior propodeum rugose. Posterior propodeum tessellate. Dorsal face of T1 punctation fine and dense (IS < 1 PD). T2 basal impression deep, approximately 1/2 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus yellow. Supraclypeal area yellow to within 1 MOD of antennal socket. Lower paraocular area yellow from 1 MOD from antennal socket medially extending along margin of compound eye terminating in line with ventral tangent of antennal socket. Labral process yellow. Mandible yellow. Scape yellow anteriorly. Flagellomeres dark. Pronotal lobe yellow. Tegula yellow. Wing veins and stigma brown, membrane light brown. Fore tibia yellow anteriorly dark posteriorly, mid and hind tibia yellow apically and basally. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity long, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium-length, sparse. S4 pubescence medium-length, sparse. S5 pubescence long, medially directed apicolateral fringes.

Female:

Structure: Body length range 7.0–8.25 mm. Head broader than long (HL/HW ratio 0.86). Face below antennae convex. Labral process anchor shaped, longer than broad, apex rounded. Clypeus without median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.03). Posterior ocelli 0.40 mm apart. Flagellomeres broader than long. Dorsal pronotal carina absent. Prosternum conically produced. ITD 1.65 mm. Metapostnotum weakly extended medially <25% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.08 mm.

Sculpture: Clypeus punctation fine and sparse medially (IS = 1 PD) coarser and denser laterally (IS < 1 PD). Paraocular punctation fine and dense (IS < 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 1/2 way down antennal socket. Frons punctation fine and dense (IS < 1 PD). Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation very fine and sparse (IS = 1 PD). Scutellum punctation fine and sparse (IS = 1 PD). Mesopleuron punctation fine and sparse (IS = 1 PD). Lateral propodeum punctation fine and dense (IS < 1 PD). Posterior propodeum punctation absent. Posterior propodeum tessellate. Dorsal face of T1 punctation impunctate. T2 basal impression shallow, approximately 1/4 of T2 lineolate basally. T3 punctation absent. T4 punctation absent.

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F4-F9 yellow ventrally. Pronotal lobe black. Tegula yellow. Wing veins and stigma yellow, membrane hyaline. Fore and mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, yelow/brown. Scutellum pilosity long, yellow/brown. Mesopleuron pilosity long, yellow/brown. Sternite pubescence colour yellow. S3 pubescence

medium-length, sparse. S4 pubescence medium-length, sparse. S5 pubescence long, medially directed apicolateral fringes.

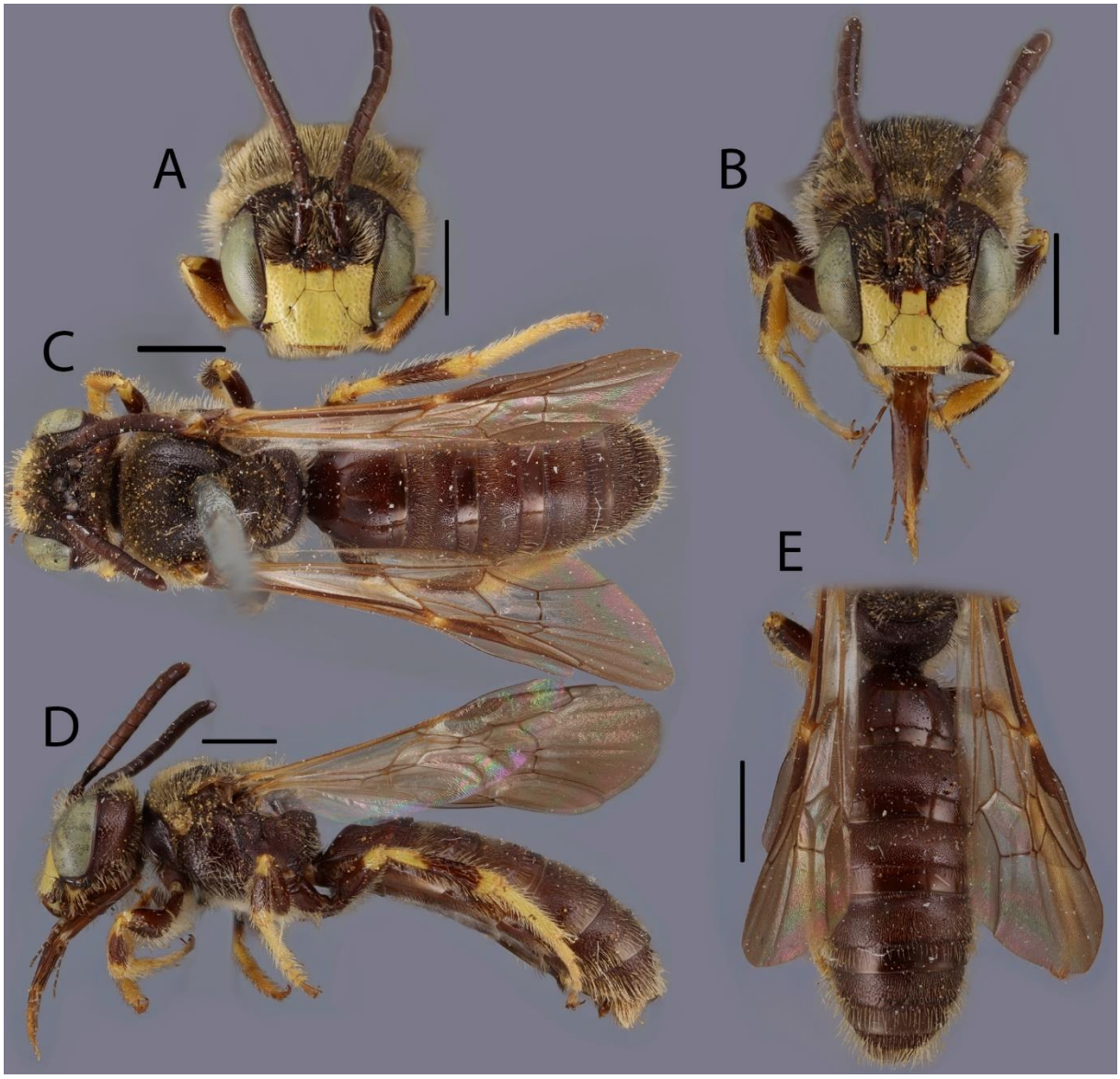


Figure 93. *Protandrena* (*Pterosarus*) *piercei*, ♂. AMNH_00176100 face light, AMNH_00176104 face dark. **A.** Face (light). **B.** Face (dark). **C.** Dorsal habitus. **D.** Lateral habitus. **E**. Metasoma. Scale bars: 1 mm.

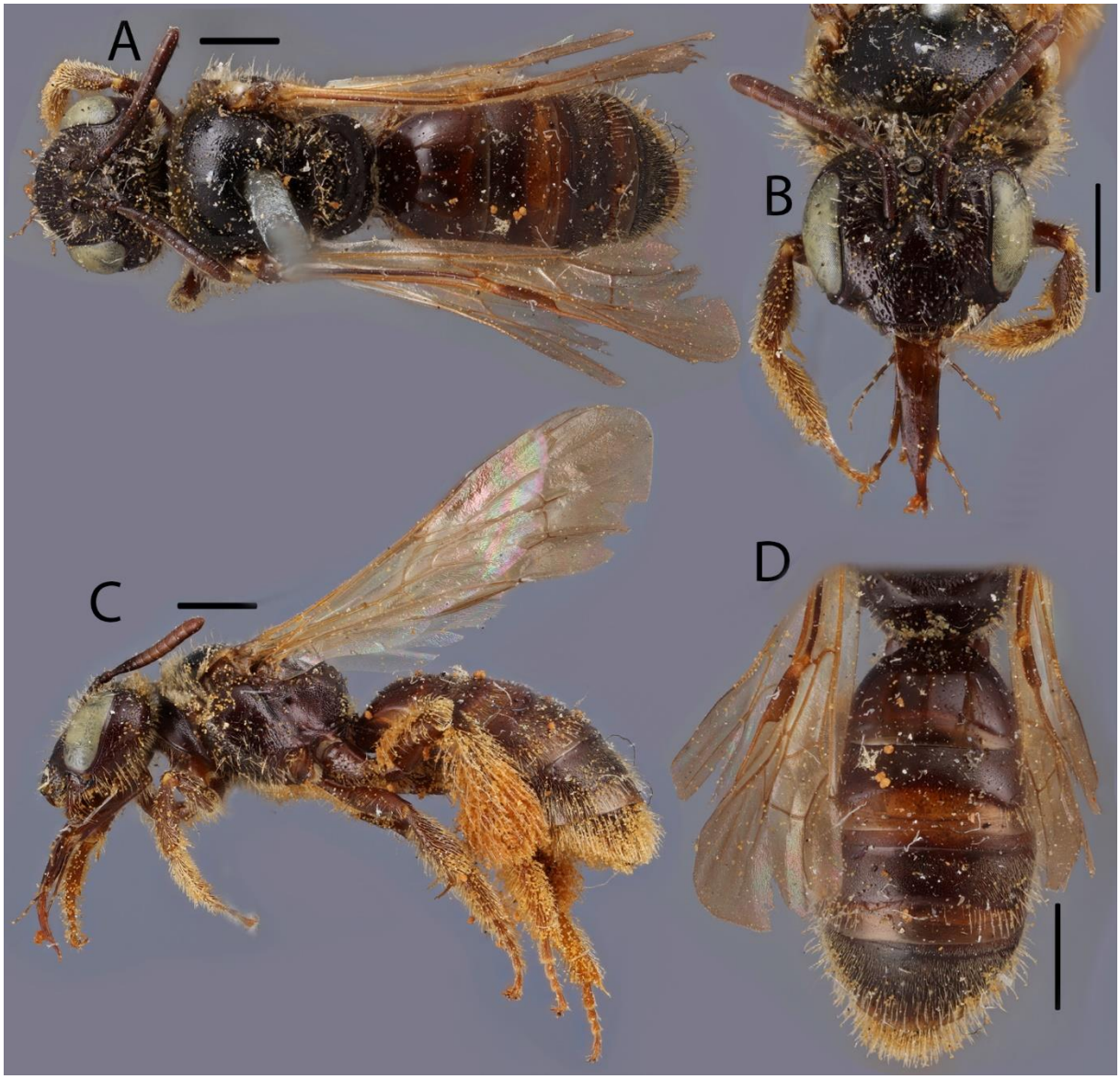


Figure 94. Protandrena (*Pterosarus*) *piercei*, ♀. CUIC. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena piercei* is active from late July to late September. Hicks (1936) caught a female that was making its nest. The female was caught in a slightly curved tunnel approximately 4.5 cm deep. Hicks (1936) discovered another nest site located in a drying crack

of earth at Base Line Lake near Boulder Colorado. Floral records for the species are poor, but most of the female records are on the tribe Heliantheae.

Range: Canada (Alberta, Manitoba, Saskatchwan), USA (Colorado, Minnesota, Montana, Nebraska, New Mexico, North Dakota).

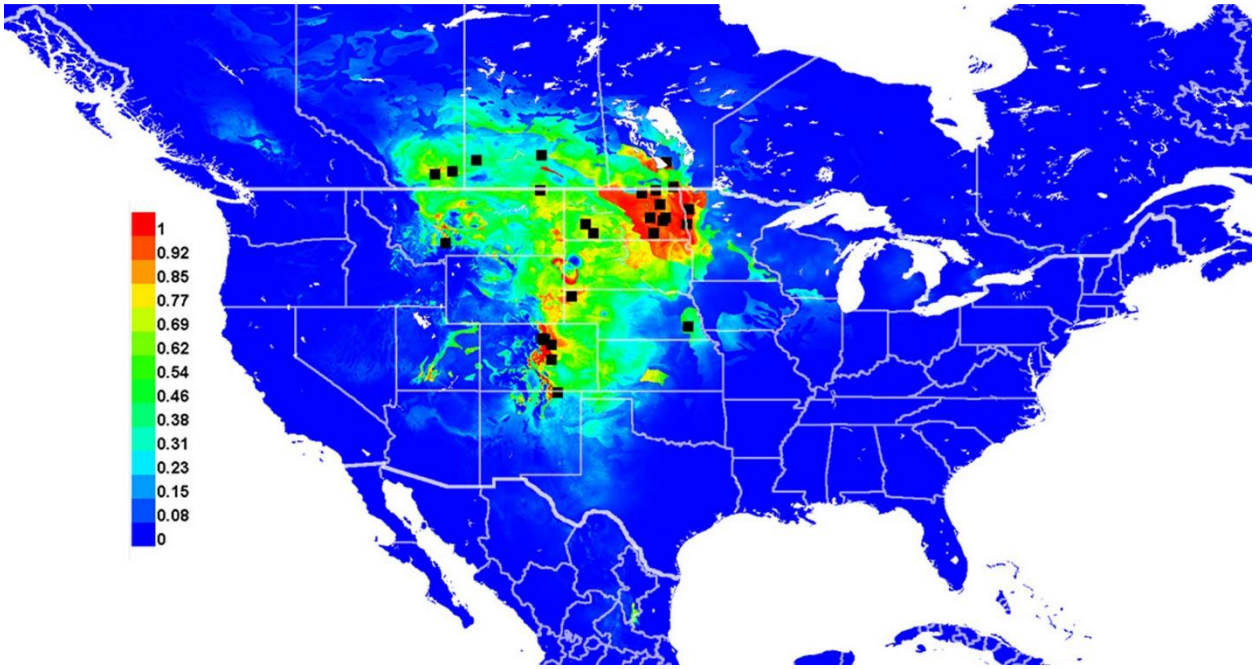


Figure 95. Georeferenced collection records of *Protandrena* (*Pterosarus*) *piercei* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *planafacialis* new species**

(Figure 96)

Etymology:

The specific epithet *planafacialis* is derived from the Latin plana (‘flat’) and facialis (‘of the face’) referring to the flatness of the face in the male.

Diagnosis:

Males of *Pr*. (*Pt*.) *planafacialis* can be recognized by a combination of their iniformly fine and dense scutum punctures (IS < 1 PD) (contrast all except: *Pr*. *albipes, Pr*. *aurifodinae, Pr*. *bilobata, Pr*. *ornatipes, Pr*. *perlaevis, Pr*. *piercei, Pr*. *quadrapylae, Pr*. *vigvierae*), finely reticulate posterior face of propodeum (contrast *Pr*. *aurifodinae, Pr*. *perlaevis, Pr*. *piercei, Pr*. *vigvierae*) and face flattened below antennae (contrast remaining).

Material examined:

USA – **New Mexico** • 1♂; Guadalupe, Santa Rosa; [34.9387° N, 104.6825° W]; 26 Aug. 1962; Triplehorn C.A., W.E. leg.; OSUC

Description:

Male:

Structure: Body length range 5.92 mm. Head broader than long (HL/HW ratio 0.88). Face below antennae flat. Labral process narrowly trapezoidal, broader than long, apex emarginate. Clypeus with median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.26). Posterior ocelli 0.31 mm apart. Flagellomeres longer than broad. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.1 mm. Metapostnotum strongly extended medially >50% way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.15 mm. S6 notch deep, extending approximately 1/2 of disk, lateral carina absent.

Sculpture: Clypeus punctation coarse and dense laterally (IS < 1 PD) absent medially. Paraocular punctation coarse and dense (IS < 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 0.5 MOD from dorsal

tangent of antennal socket. Frons coarsely reticulate. Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation fine and dense (IS < 1 PD). Scutellum punctation coarse and sparse (IS = 1 PD) denser medially (IS < 1 PD). Mesopleuron punctation fine and sparse (IS = 1 PD). Lateral propodeum finely reticulate. Posterior propodeum finely reticulate. Posterior propodeum tessellate. Dorsal face of T1 punctation fine and dense (IS < 1 PD). T2 basal impression deep, approximately 1/2 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus yellow. Supraclypeal area yellow to within 1 MOD of antennal socket. Lower paraocular area yellow forming straight line with supraclypeal mark 0.5 MOD from ventral tangent of antennal socket. Labral process yellow. Mandible yellow. Scape black. Flagellomeres dark. Pronotal lobe yellow. Tegula light brown. Wing veins and stigma light brown, membrane hyaline. Fore tibia yellow anteriorly dark posteriorly, mid and hind tibia yellow apically and basally. Tarsi yellow.

Pubescence: Mesoscutum pilosity medium-length, yellow/brown. Scutellum pilosity long, yellow/brown. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium-length, sparse. S4 pubescence medium-length, sparse. S5 pubescence medium-length, sparse.

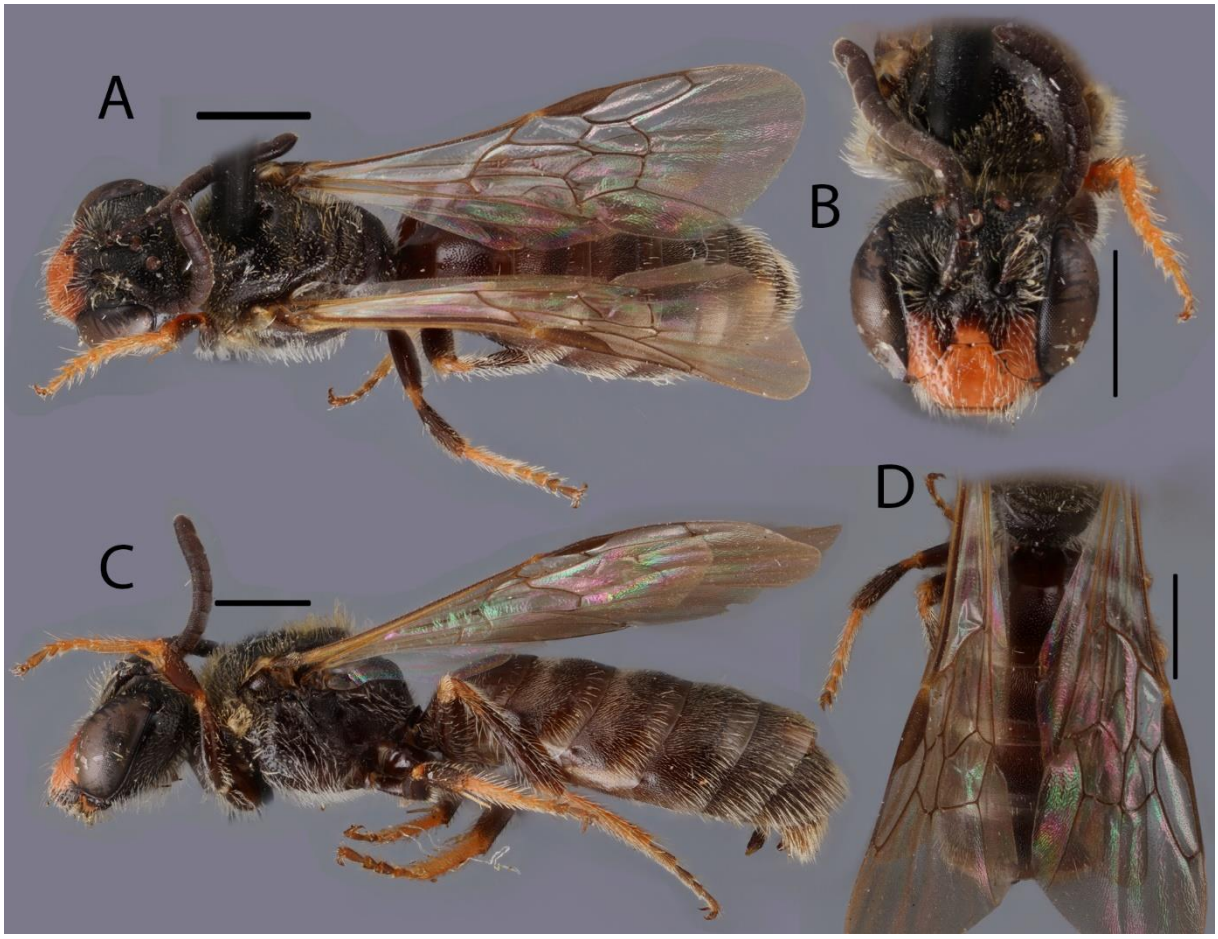


Figure 96. *Protandrena* (*Pterosarus*) *planafacialis*, ♂. OSUC_596821. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

***Protandrena* (*Pterosarus*) *prata* new species**

(Figure 97, Figure 98)

Holotype: ♂ Canada – Alberta • Empress (11.8 km SSW); [50.8504° N, 110.0489° W]; 11 Jun. 2019; Onuferko T.M. leg.; TOPC

Etymology

The specific epithet is *prata* is formed from the Latin pratum (‘prairie’) referring to the collection location of many of the specimens in Grasslands National Park.

Diagnosis:

Males of *Pr.* (*Pt.*) *prata* can be recognized by a combination of their scutum punctures of two types coarse and very fine (contrast all except: *Pr. atricornis*, *Pr. citrinifrons*, *Pr. didirupa*, *Pr. occultata*, *Pr. leucoptera*, *Pr. luxsolaris*), and scutum punctures that are sparse medially (IS = 1 PD) and denser laterally (IS < 1 PD) (contrast remaining).

Females of *Pr.* (*Pt.*) *prata* can be recognized by their scutum punctures of two types coarse and very fine (contrast all except: *Pr. atricornis*, *Pr. citrinifrons*, *Pr. didirupa*, *Pr. occultata*, *Pr. leucoptera*, *Pr. luxsolaris*) finely reticulate posterior face of propodeum (contrast atricornis leucoptera luxsolaris), and scutum punctures that are sparse medially (IS > 2 PD) but dense laterally (IS < 1 PD) (contrast remaining).

Material examined:

CANADA – **AB or SK** • 2♀♀; Cypress or Division 4, Onefour or Grasslands National Park; 05 Jul. 2010; de Silva N. leg.; PMAE– **Alberta** • 1♀; Kneehill, Tolman, Postill Farm; [51.8231° N, 113.0117° W]; 18 Jul. 2016; Buck M. leg.; PMAE • 1♀, 1♂♂; Empress (11.8 km SSW); [50.8504° N, 110.0489° W]; 11 Jun. 2019; Onuferko T.M. leg.; TOPC– **Saskatchewan** • 1♀; Division 4, Grasslands National Park; [49.1432° N, 107.4468° W]; 11 Jul. 1996; Finnamore A.T. leg.; PMAE • 2♀♀; Division 4, Grasslands National Park; [49.2149° N, 107.6476° W]; 17 Jul. 1996; Finnamore A.T. leg.; PMAE • ♂; same location as preceding; 17 Jul. 1996; Finnamore A.T. leg.; PMAE • 1♂; Division 4, Grasslands National Park; [49.0625° N, 107.6548° W]; 18

Jul. 1996; Finnamore A.T. leg.; PMAE • 1♀; Division 4, Hatton; 50.0333° N, 109.8333° W; 26 Jun. 1979; Maw M.G. leg.; CNC

Description

Male:

Structure: Body length range 5.82–6.45 mm. Head broader than long (HL/HW ratio 0.88). Face below antennae convex. Labral process trapezoidal, broader than long, apex emarginate. Clypeus without median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.25). Posterior ocelli 0.3 mm apart. Flagellomeres longer than broad. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.05 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.19 mm. S6 notch shallow, less than 1/3 of disk, lateral carina absent.

Sculpture: Clypeus punctation fine and dense (IS < 1 PD). Paraocular punctation fine and dense (IS < 1 PD). Supraclypeal area punctation fine and dense (IS < 1 PD). Fovea clavate. Foveae converging above, narrow end terminating in line with dorsal tangent of antennal socket. Frons finely reticulate. Vertex punctation fine and dense (IS < 1 PD). Mesoscutum punctation fine and sparse medially (IS = 1 PD) denser laterally (IS < 1 PD). Scutellum punctation fine and dense (IS < 1 PD). Mesopleuron punctation fine and sparse (IS = 1 PD). Lateral propodeum finely reticulate. Posterior propodeum finely reticulate. Posterior propodeum not microsculptured. Dorsal face of T1 punctation fine and dense (IS < 1 PD). T2 basal impression deep, approximately 1/3 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus yellow. Supraclypeal area yellow to within 0.5 MOD of antennal socket. Lower paraocular area yellow reaching ventral tangent of antennal socket medially, extending along margin of compound eye terminating 1/2 up antennal socket. Labral process yellow. Mandible yellow. Scape yellow anteriorly. Flagellomeres F2-F8 yellow ventrally. Pronotal lobe black. Tegula brown. Wing veins and stigma light brown, membrane hyaline. Fore tibia yellow anteriorly dark posteriorly, mid and hind tibia with reduced dark spot medially. Tarsi yellow.

Pubescence: Mesoscutum pilosity medium-length, white. Scutellum pilosity medium-length, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium-length, sparse. S4 pubescence medium-length, sparse. S5 pubescence long, medially directed apicolateral fringes.

Female:

Structure: Body length range 5.98–7 mm. Head broader than long (HL/HW ratio 0.84). Face below antennae convex. Labral process trapezoidal, broader than long, apex truncate. Clypeus with median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.05). Posterior ocelli 0.34 mm apart. Flagellomeres broader than long. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.31 mm. Metapostnotum weakly extended medially <25% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.063 mm.

Sculpture: Clypeus punctation fine and dense (IS < 1 PD). Paraocular punctation fine and dense (IS < 1 PD). Supraclypeal area punctation fine and dense (IS < 1 PD). Fovea clavate. Foveae converging above, narrow end terminating in line with dorsal tangent of antennal socket. Frons punctation fine and dense (IS < 1 PD). Vertex punctation fine and dense (IS < 1 PD). Mesoscutum punctation fine and sparse medially (IS > 2 PD) denser laterally (IS < 1 PD).

Scutellum punctation fine and sparse (IS = 1 PD). Mesopleuron punctation fine and sparse (IS = 1 PD). Lateral propodeum finely reticulate. Posterior propodeum finely reticulate. Posterior propodeum not microsculptured. Dorsal face of T1 punctation very fine and sparse anteriorly (IS = 1 PD) sparser posteriorly (IS > 5 PD). T2 basal impression shallow, approximately 1/2 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation sparse (IS = 1 PD).

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F3-F10 yellow ventrally. Pronotal lobe black. Tegula yellow. Wing veins and stigma light brown, membrane hyaline. tibia dark except yellow spot at knee. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, yellow. Scutellum pilosity medium-length, yellow. Mesopleuron pilosity long, yellow. Sternite pubescence colour yellow. S3 pubescence medium-length, sparse. S4 pubescence medium-length, sparse. S5 pubescence medium-length, sparse.

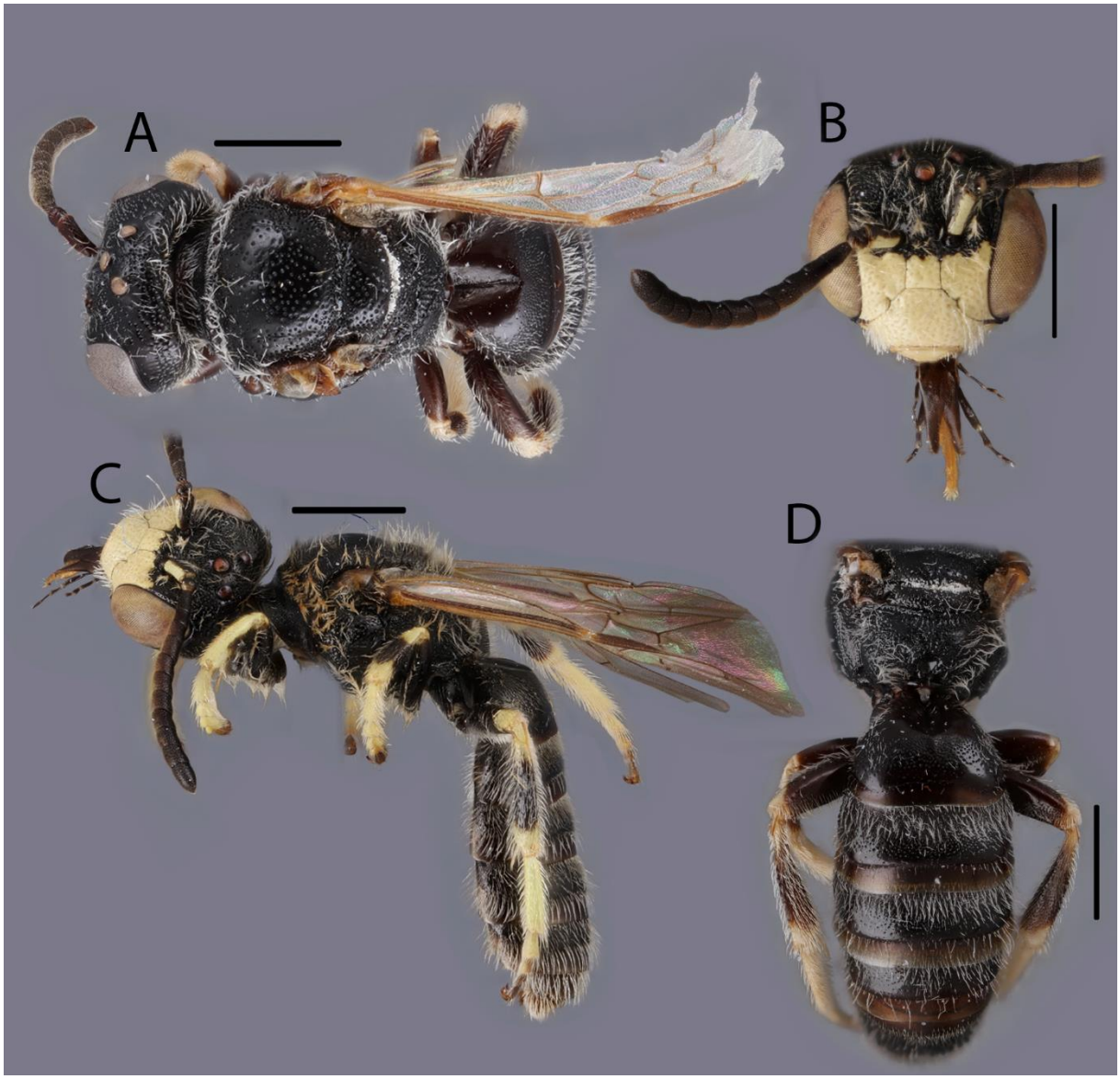


Figure 97. *Protandrena* (*Pterosarus*) *prata*, ♂. TOPC. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

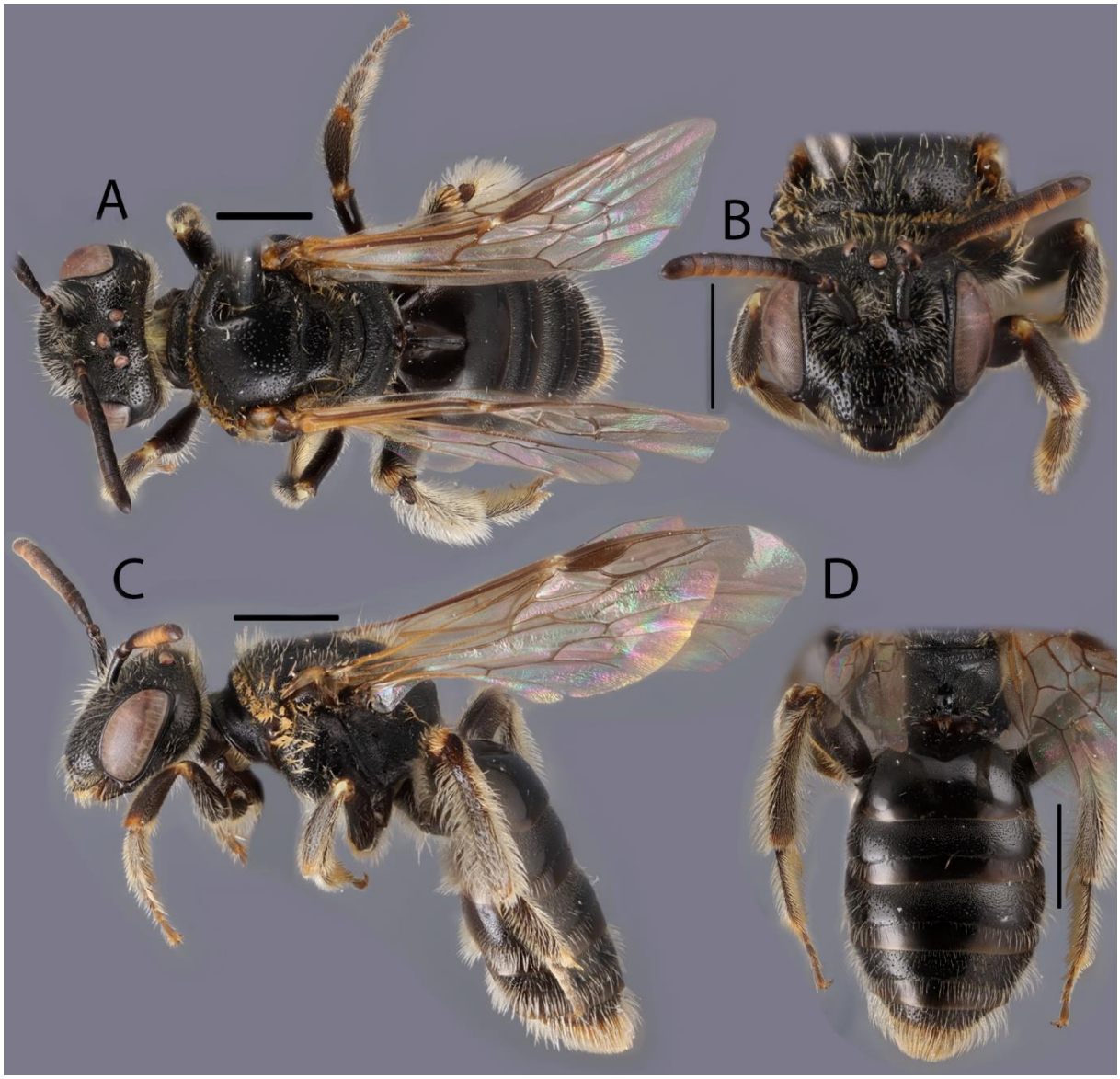


Figure 98. *Protandrena* (*Pterosarus*) *prata*, ♀. TOPC. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena prata* is active from mid-June to mid-July.

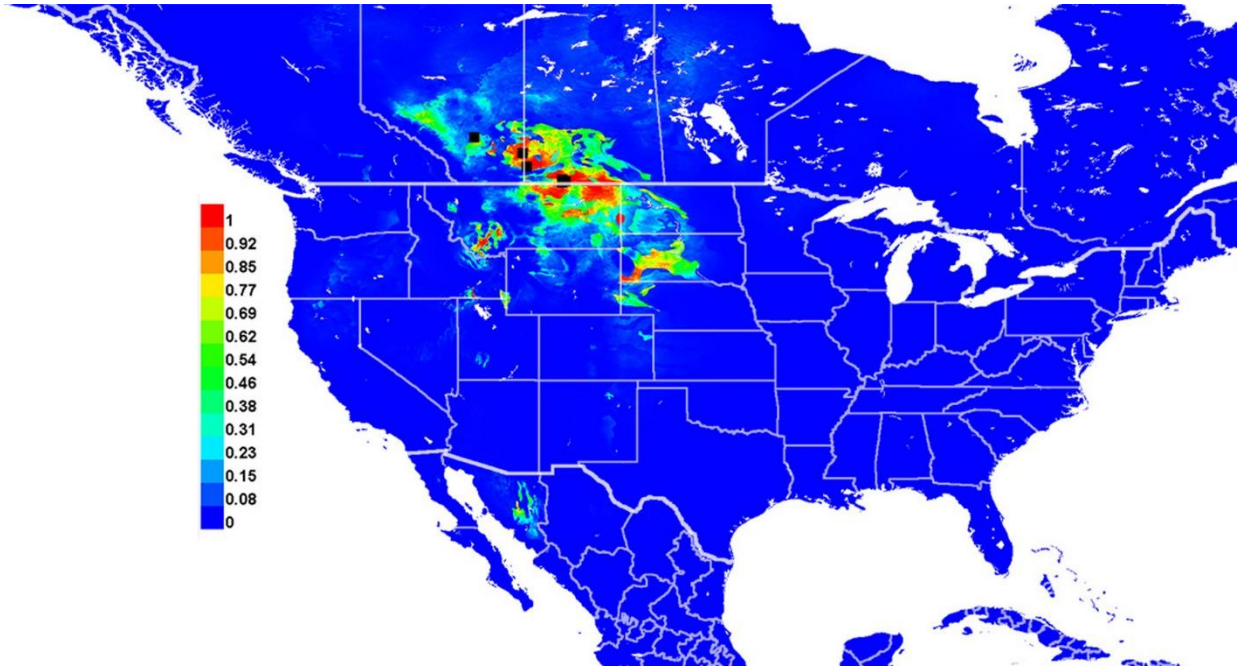


Figure 99. Georeferenced collection records of *Protandrena* (*Pterosarus*) *prata* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *quadrapylae* new species**

(Figure 100, Figure 101)

Holotype: ♂ USA – Oklahoma • Ellis, Four Canyons Preserve, Horse Canyon; [36.0282° N, 99.5065° W]; 21 Sep. 2008; Arduser M. leg.; ex *Gutierrezia* sp.; MAPC

Etymology:

The specific epithet *quadrapylae* is formed from “quadra” (four) and the Latin “pylae” (canyon). In reference to the four canyons preserve from which the type is collected.

Diagnosis:

Males of *Pr*. (*Pt*.) *quadrapylae* can be recognized by a combination of their finely densely punctate scutum (IS < 1 PD) (contrast all except: *Pr*. *albipes, Pr*. *aurifodinae, Pr*. *bilobata, Pr*. *ornatipes, Pr*. *perlaevis, Pr*. *piercei, Pr*. *planafacialis, Pr*. *vigvierae*), yellow pronotal lobes (contrast *Pr*. *albipes, Pr*. *aurifodinae, Pr*. *vigvierae*), and sparse mesopleuron punctation (IS > 1 PD) (contrast remaining).

Females of *Pr*. (*Pt*.) *quadrapylae* can be recognized by a combination of their sparse scutum punctures (IS = 1 PD) (contrast all except: *Pr*. *piercei* and *Pr*. *leucoptera*), and yellow pronotal lobes (contrast remaining).

Material examined:

USA – **Oklahoma** • 1♀, 1♂♂; Cleveland, Norman, Saxon Park; [35.1841° N, 97.3901° W]; 04 Oct. 2021; Hung K.L.J. leg.; ex *Amphiachyris* dracunculoides; OMNH: JH • 1♀; Cleveland, Norman, University of Oklahoma; [35.1887° N, 97.4411° W]; 02 Dec. 2021; Hung K.L.J. leg.; ex *Symphyotrichum subulatum*; OMNH: JH • 1♀; same location as preceding; 09 Nov. 2021; Hung K.L.J. leg.; ex *Symphyotrichum subulatum*; OMNH: JH • 1♀; Ellis, Four Canyons Preserve HQ; [36.0282° N, 99.5065° W]; 21 Sep. 2008; Arduser M. leg.; MAPC • 1♂; Ellis, Four Canyons Preserve, Horse Canyon; [36.0282° N, 99.5065° W]; 21 Sep. 2008; Arduser M. leg.; ex *Gutierrezia* sp.; MAPC

Description

Male:

Structure: Body length range 6.11–6.71 mm. Head broader than long (HL/HW ratio 0.85). Face below antennae convex. Labral process trapezoidal, broader than long, apex emarginate.

Impressed median line of clypeus weakly present. Compound eyes strongly convergent below (UOD/LOD ratio 1.28). Posterior ocelli 0.29 mm apart. Flagellomeres longer than broad. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.09 mm. Metapostnotum not extended medially. Tarsi 2–4 triangular. Fore tarsi width 0.16 mm. S6 notch shallow, less than 1/3 of disk, lateral carina absent.

Sculpture: Clypeus punctation fine and dense (IS < 1 PD). Paraocular punctation fine and dense (IS < 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 1 MOD from dorsal tangent of antennal socket. Frons finely reticulate. Vertex punctation fine and dense (IS < 1 PD). Mesoscutum punctation fine and dense (IS < 1 PD). Scutellum punctation fine and sparse laterally (IS > 1 PD) denser medially (IS < 1 PD). Mesopleuron punctation fine and sparse (IS > 1 PD). Lateral propodeum finely reticulate. Posterior propodeum finely reticulate. Posterior propodeum tessellate. Dorsal face of T1 punctation fine and dense (IS < 1 PD). T2 basal impression deep, approximately 1/3 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus yellow. Supraclypeal area yellow in line with ventral tangent of antennal socket. Lower paraocular area yellow forming straight line with supraclypeal mark reaching ventral tangent of antennal socket. Labral process yellow. Mandible yellow. Scape yellow anteriorly. Flagellomeres F2-F9 yellow ventrally. Pronotal lobe yellow. Tegula brown. Wing veins and stigma light brown, membrane light brown. Fore tibia yellow anteriorly dark posteriorly, mid and hind tibia yellow posteriorly, apically, and basally dark medially and anteriorly. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity medium-length, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium-

length, sparse. S4 pubescence medium-length, sparse. S5 pubescence long, medially directed apicolateral fringes.

Female:

Structure: Body length range 6.23–7.55 mm. Head broader than long (HL/HW ratio 0.82). Face below antennae convex. Labral process trapezoidal, broader than long, apex rounded. Impressed median line of clypeus weakly present. Compound eyes weakly convergent below (UOD/LOD ratio 1.06). Posterior ocelli 0.35 mm apart. Flagellomeres broader than long. Dorsal pronotal carina extends laterally to pronotal lobes. Prosternum not produced. ITD 1.41 mm. Metapostnotum weakly extended medially <25% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.07 mm.

Sculpture: Clypeus punctation fine and sparse (IS = 1 PD). Paraocular punctation fine and sparse (IS = 1 PD). Supraclypeal area punctation fine and sparse (IS = 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 0.5 MOD from dorsal tangent of antennal socket. Frons finely reticulate. Vertex punctation fine and sparse (IS = 1 PD). Mesoscutum punctation very fine, sparse (IS = 1 PD). Scutellum punctation fine and sparse laterally (IS > 1 PD) denser medially (IS < 1 PD). Mesopleuron punctation fine and sparse (IS > 1 PD). Lateral propodeum finely reticulate. Posterior propodeum finely reticulate. Posterior propodeum tessellate. Dorsal face of T1 punctation very minute and sparse (IS > 10 PD). T2 basal impression shallow, approximately 1/2 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F3-F10 yellow ventrally. Pronotal lobe

yellow. Tegula yellow. Wing veins and stigma light brown, membrane hyaline. Fore and mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, yellow. Scutellum pilosity medium-length, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium-length, sparse. S4 pubescence medium-length, sparse. S5 pubescence medium-length, sparse.

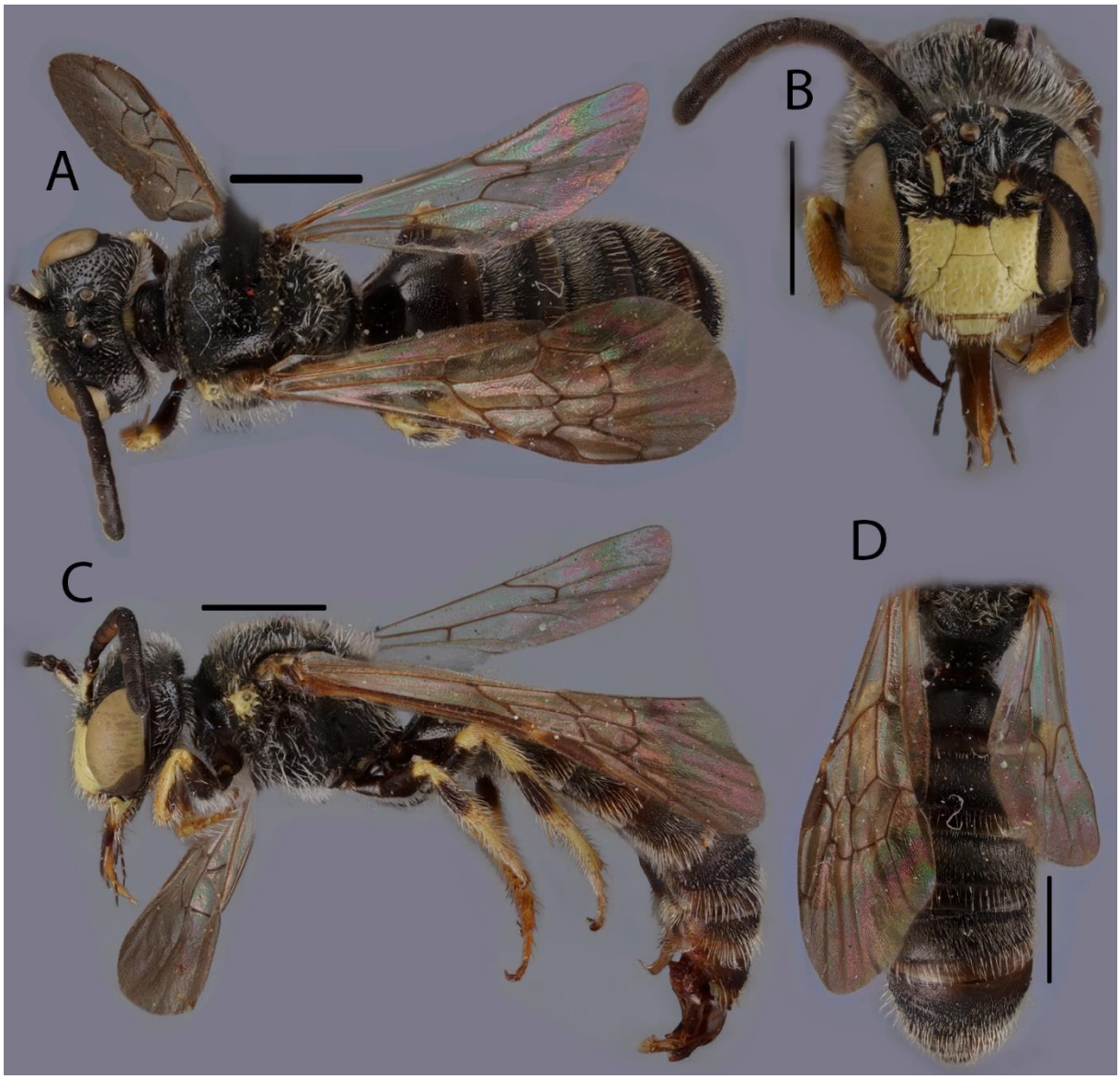


Figure 100. *Protandrena* (*Pterosarus*) *quadrapylae*, ♂. MAPC. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

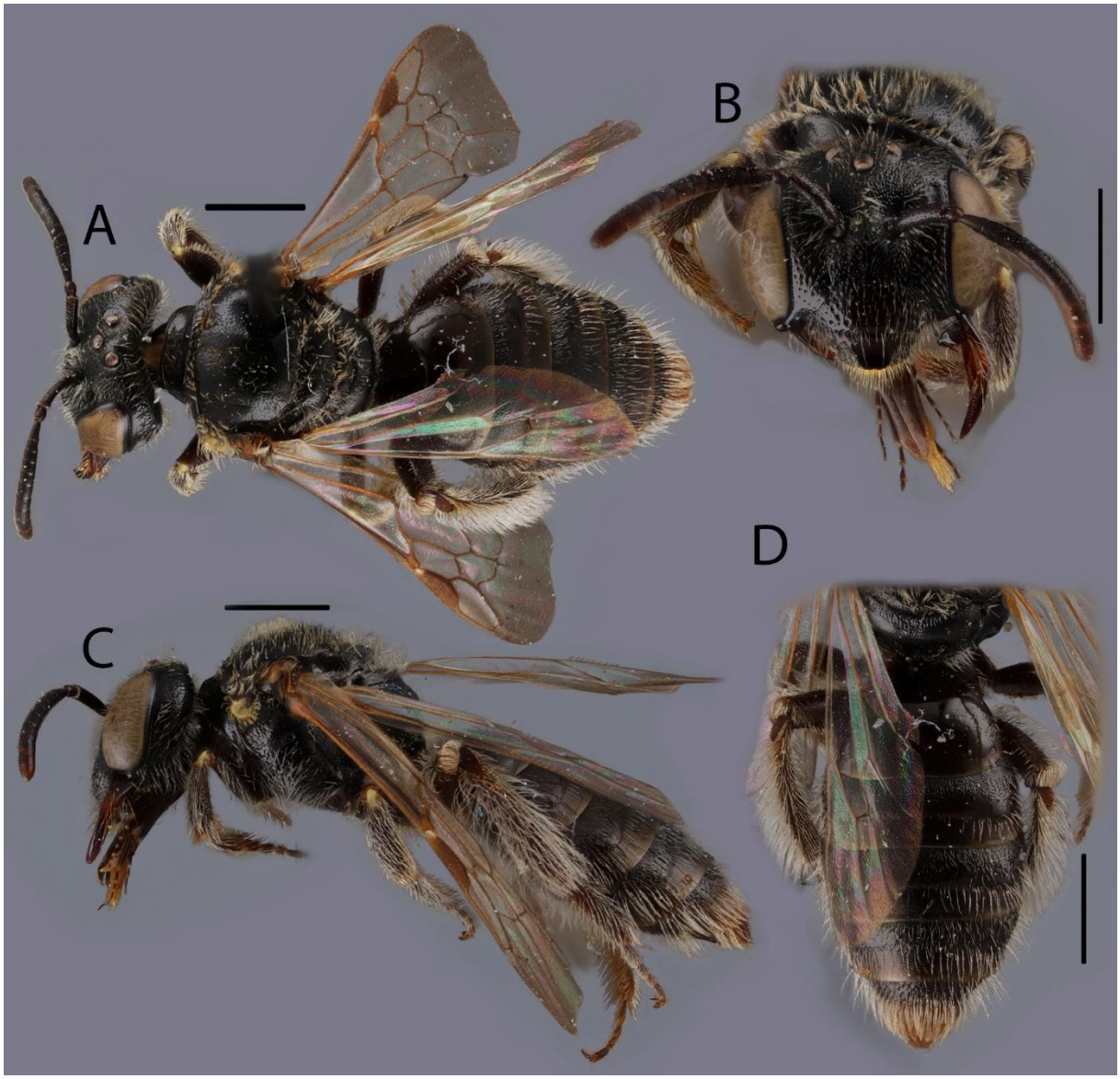


Figure 101. *Protandrena* (*Pterosarus*) *quadrapylae*, ♀. MAPC. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena quadrapylae* is active from late September to early November. Floral records for the species are poor, but all records are on the tribe Astereae.

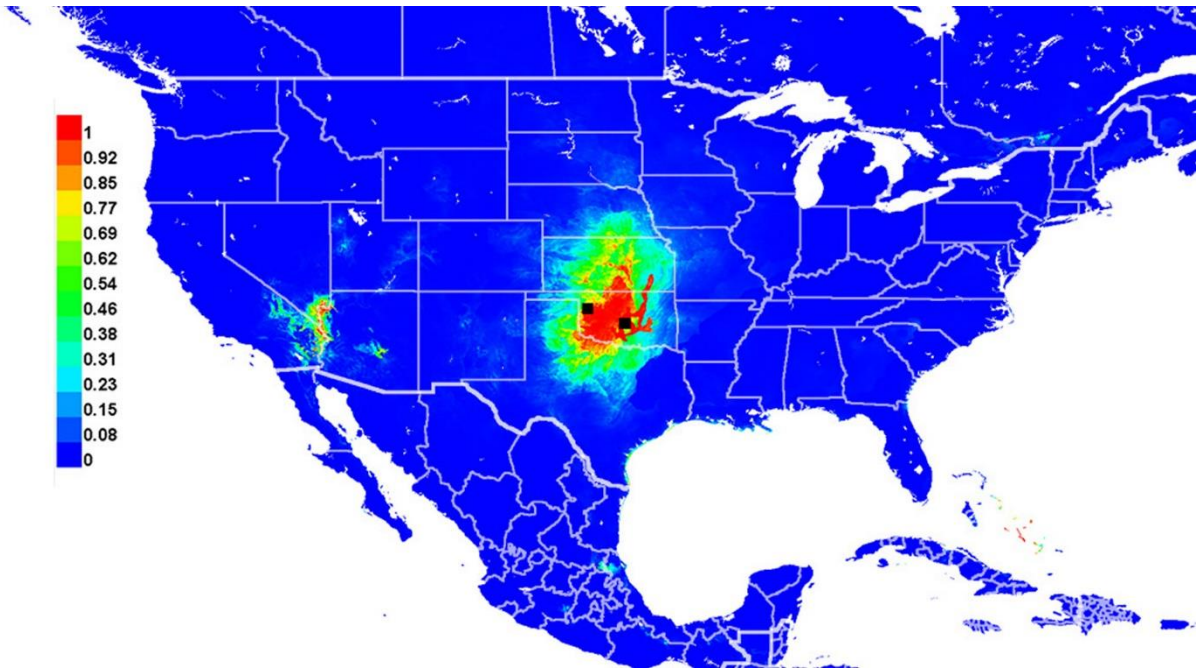


Figure 102. Georeferenced collection records of *Protandrena* (*Pterosarus*) *quadrapylae* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *renimaculata* (Cockerell)**

(Figure 103, Figure 104)

Calliopsis renimaculatus Cockerell, 1896c: 222. ♀ Syntype NMNH: 533813. Type locality: USA; Colorado: Fort Collins. 15 Aug 1895 ex. *Solidago canadensis*. Examined by photos.

Taxonomy: Swenk and Cockerell, 1907: 180. – Crawford, 1915: 579. ♂♀. – Stevens, 1919: 208. – Stevens, 1950: 93 (redescription). – Timberlake, 1967 (key).

Type specimens: Cockerell (1896c) described the female of *Calliopsis renimaculatus* the number of specimens was not indicated, and no type specimen was selected. I select specimen 533813 as the lectotype.

Diagnosis:

Males of *Pr*. (*Pt*.) *renimaculata* can be recognized by a combination of their uniformly coarse and dense scutum punctures (IS < 1 PD) (contrast all except: *Pr*. *citrinifrons, Pr*. *solidaginis, Pr*. *vicina*) and flattened face below antennae (contrast remaining).

Females of *Pr*. (*Pt*.) *renimaculata* can be recognized by a combination of their uniformly fine and dense scutum punctures (IS < 1 PD) (contrast all except: *Pr*. *albipes, Pr*. *citripes, Pr*. *occidua, Pr*. *ornatipes, Pr*. *subtilis, Pr*. *vigvierae*), reticulate posterior face of propodeum (contrast *Pr*. o*rnatipes, Pr*. *subtilis*, *Pr*. *vigvierae*) and yellow maculation on face (contrast remaining).

Material examined:

CANADA – **Alberta** • 1♀; 40 Mile; [49.6686° N, 111.4283° W]; elev. 831 m.; 20 Aug. 2011; Zink L. leg.; UCMZ • 1♀; Division 1, Canadian Forces Base Suffield, Suffield Wildlife Management Area; 50.6333° N, 110.3° W; 16 Aug. 1995; Pollock, Finnamore leg.; PMAE • 1♀; Division 1, Medicine Hat; [50.0333° N, 110.6833° W]; 31 Jul. 1925; Carr F.S. leg.; CNC • 1♀; Division 2, Lethbridge; [49.7° N, 112.8333° W]; 19 Aug. 1981; Galloway T.D. leg.; WRME • 1♀; same location as preceding; 08 Sep. 1939; Salt R.W. leg.; CNC • 1♀; same location as preceding; 21 Aug. 1940; Salt R.W. leg.; CNC • 1♀, 5♂♂; Division 2, Lethbridge; 49.6996° N, 112.8487° W; 10 Aug. 2015; Sheffield C. leg.; ex *Grindelia squarrosa*; RSKM • 1♀; Division 2, Taber; [49.7833° N, 112.15° W]; 20 Aug. 1957; Brooks A.R., Brooks J.E. leg.; CNC • 2♀♀; Division 5, Drumheller; [51.4667° N, 112.7° W]; 11 Aug. 1957; Brooks A.R., Brooks J.E. leg.; CNC • 1♂; Division 7, Wainwright; [52.8333° N, 110.8667° W]; 27 Jul. 1957; Brooks A.R., Brooks J.E. leg.; CNC • 1♀; Taber; [49.7483° N, 111.6964° W]; elev. 817 m.; 22 Aug. 2011;

Zink L. leg.; UCMZ • 1♀; Aldersyde; [50.6774° N, 113.9517° W]; elev. 1041 m.; 17 Aug. 2016; Johnson S. leg.; UCMZ • 1♀; Arrowood (near); [50.7638° N, 113.1901° W]; elev. 907 m.; 09 Aug. 2016; Johnson S. leg.; UCMZ • 1♀; Calgary; [50.6014° N, 114.051° W]; elev. 1043 m.; 09 Aug. 2017; Gavin M.P. leg.; UCMZ • 1♂; Cranford; [49.7859° N, 112.4196° W]; elev. 838 m.; 15 Jul. 2016; Robinson S. leg.; UCMZ • 1♂; Rycroft; [55.7667° N, 118.7167° W]; 07 Aug. 1961; Brooks A.R. leg.; CNC – **Manitoba** • 1♂; Division 11, St. James; [49.9° N, 97.25° W]; 19 Aug. 1962; Garland J.A. leg.; WRME • 9♀♀; Division 14, Oak Hammock Marsh; 50.172° N, 97.135° W; 12 Aug. 2020; Gibbs J. leg.; ex *Grindelia squarrosa*; WRME • 1♀; Division 14, Oak Hammock Marsh; 50.142° N, 97.184° W; 07 Aug. 2019; Hanuschuk E. leg.; WRME • 1♀, 8♂♂; Division 16, Russell; [50.7833° N, 101.2833° W]; 16 Aug. 1954; Brooks, Wallis leg.; CNC • 1♀; Division 18, Saint Laurent (7 km NNE); 50.474° N, 97.923° W; 25 Jul. 2020; Shukla-Bergen S. leg.; ex *Symphyotrichum* ericoides; WRME • 1♀; Division 19, Saint Martin (7.5 km SSW); 51.652° N, 98.715° W; 24 Aug. 2020; Shukla-Bergen S. leg.; ex *Grindelia squarrosa*; WRME • 1♀; Division 7, Yellow Quill Prarie Preserve; 49.6808° N, 99.5566° W; 20 Sep. 2005; Patenaude A.M. leg.; WRME • 1♂; Glenlea; [49.6351° N, 97.1537° W]; 14 Aug. 1970; Ellis R. leg.; WRME – **Saskatchewan** • 1♂; Division 2, Minton; [49.1667° N, 104.5833° W]; 12 Aug. 1955; Miller C.D. leg.; CNC • 1♂; Division 3, Lisieux; [49.2781° N, 105.9738° W]; 04 Aug. 1955; Miller C.D. leg.; CNC • 1♂; same location as preceding; 04 Aug. 1955; Brooks A.R. leg.; CNC • 1♀, 2♂♂; Division 3, Wood Mountain; [49.3667° N, 106.3833° W]; 05 Aug. 1955; Miller C.D. leg.; CNC • 1♂; same location as preceding; 05 Aug. 1955; Brooks A.R. leg.; CNC • 1♀; Division 3, Wood Mountain Provincial Park; 49.3198° N, 106.8825° W; 14 Aug. 2018; RSM Bee team leg.; RSKM • 1♀; Division 3, Woodrow; 49.6954° N, 106.7256° W; 20 Sep. 2015; Sheffield C. leg.; RSKM • 2♀♀, 2♂♂; Division 3 , Rockglen; [49.1833° N, 105.95° W];

02 Aug. 1955; Brooks A.R. leg.; CNC • 1♀; Division 4, Cypress Hills; 49.5708° N, 109.8966° W; 13 Jul. 2013; Sheffield C. leg.; RSKM • 4♀♀; same location as preceding; 14 Jul. 2013; Frier D., Sheffield C. leg.; RSKM • 1♀; same location as preceding; 14 Jul. 2013; Crosby A. leg.; RSKM • 1♀; same location as preceding; 15 Jul. 2013; Frier D., Sheffield C. leg.; RSKM • 2♀♀; Division 4, Eastend , T-Rex Discovery centre; 49.5217° N, 108.8289° W; 01 Aug. 2017; Sheffield C. leg.; RSKM • 2♀♀; Division 4, Eastend ; 49.5129° N, 108.7959° W; 11 Aug. 2014; Sheffield C. leg.; ex *Grindelia squarrosa*; RSKM • 1♀; Division 4, Frenchman Valley Campground; 49.2916° N, 108.4047° W; 01 Aug. 2017; Oram R. leg.; ex *Grindelia squarrosa*; RSKM • 1♀; Division 4, Grasslands National Park; 49.1432° N, 107.4468° W; 14 Jul. 1996; Finnamore A.T. leg.; PMAE • 1♀; Division 4, Grasslands National Park; 49.0625° N, 107.6548° W; 18 Jul. 1996; Finnamore A.T. leg.; PMAE • 1♂; Division 4, Grasslands National Park; 49.1315° N, 107.5992° W; 28 Jul. 1996; Finnamore A.T. leg.; PMAE • 2♀♀; Division 4, Old Man on His Back Conservation Area; 49.2252° N, 109.1902° W; 10 Aug. 2017; Oram R. leg.; ex *Grindelia squarrosa*; RSKM • 1♂; Division 4, Val Marie; [49.2333° N, 107.7333° W]; 08 Aug. 1955; Miller C.D. leg.; CNC • 1♂; Division 6, B Say Tah; [50.7892° N, 103.8532° W]; 19 Aug. 1962; Herrmann K.C. leg.; CNC • 1♂; Division 6, Holdfast; [50.963° N, 105.405° W]; 07 Aug. 1925; King K.M. leg.; CNC • 1♂; Division 6, Indian Head ; [50.5333° N, 103.6667° W]; 10 Aug. 1954; Brooks, Wallis leg.; CNC • 1♀; Division 6, Qu'Appelle Valley; [50.5426° N, 103.8777° W]; 28 Aug. 1969; Michener C.D. leg.; ex *Verbesina* sp.; SEMC • 4♂♂; Division 7, Reed Lake; 50.4145° N, 109.084° W; 15 Aug. 2013; Frier D., Sheffield C. leg.; RSKM • 1♂; Great Sand Hills (NNW); 50.2341° N, 108.2403° W; 27 Jul. 2019; Onuferko T.M. leg.; TOPC • 1♂; 24 Jul. 1938; CNC

USA – **Colorado** • 1♂; Alamosa and Saguache, Great Sand Dunes National Monument ; [37.7916° N, 105.5943° W]; elev. 2316 m.; 01 Aug. 1968; Becker E.C. leg.; CNC • 1♂; Boulder, Dowe Flats, Lyons (4 mi. NE); 40.229° N, 105.347° W; elev. 1649 m.; 15 Sep. 1962; Lanham U.N., Vogel B. leg.; ex *Verbesina* sp.; UCMC • 6♀♀; Boulder, Marshall, North of Marshall; 39.9598° N, 105.2306° W; elev. 1625-1775 m.; 30 Sep. 1946; Rodeck H.G. leg.; UCMC • 1♀; same location as preceding; 12 Sep. 1946; Rodeck H.G. leg.; UCMC • 1♀; Boulder; 40.015° N, 105.2706° W; elev. 1667 m.; 12 Sep. 1946; Rodeck H.G. leg.; ex *Grindelia* sp.; UCMC • 3♀♀; Costilla, Eastdale; Dean Swift Flower Farm; 37.0182° N, 105.6118° W; elev. 2316 m.; 15 Sep. 2019; Kircus M.B. leg.; UCMC • ♂; Elbert, Running Creek Field Station; 39.2348° N, 104.6295° W; elev. 2118 m.; 10 Sep. 1979; Brown F.M. leg.; ex *Symphyotrichum* sp.; UCMC • 1♀; Grand, Kremmling (6 mi. SSE); 39.978° N, 106.353° W; elev. 2469 m.; 11 Aug. 1982; Robinson P. leg.; ex On R. Brush; UCMC • 3♀♀; same location as preceding; 07 Aug. 1982; Robinson P. leg.; ex On R. Brush; UCMC • 4♀♀; Grand, Parshall (21 mi. W); [40.0869° N, 106.552° W]; 24 Aug. 1976; Robinson P. leg.; ex *Symphyotrichum* sp.; UCMC • 1♀; Jackson, Muddy Pass; [40.3766° N, 106.5973° W]; elev. 2682 m.; 15 Aug. 1961; Poole B.H. leg.; CNC • 1♀; Larimer, Fort Collins; [40.5853° N, 105.0844° W]; 15 Aug. 1895; Baker C.F. leg.; ex *Solidago canadensis*; USNM • 2♀♀; Mesa, Loma (4 mi. N); 39.2538° N, 108.8132° W; elev. 1524 m.; 31 May. 1977; Lanham U.N., Byron P. leg.; ex Viguera sp.; UCMC • 6♂♂; same location as preceding; 31 May. 1977; Lanham U.N., Byron P. leg.; UCMC • 1♀; Rio Grande, Monte Vista NWR; Bunkhouse; 37.4619° N, 106.165° W; elev. 2338 m.; 20 Aug. 2019; Kircus M.B. leg.; ex *Chrysothamnus* sp.; UCMC • 1♀; Routt, Craig (23 mi. NE); 40.7505° N, 107.2364° W; elev. 2200-2850 m.; 01 Sep. 1979; Lanham U.N. leg.; ex *Grindelia* sp.; UCMC – **Kansas** • 1♂; Reno, Hutchinson; [38.0608° N, 97.9298° W]; 04 Sep. 1949; Michener C.D.,

Beamer leg.; ex *Heterotheca subaxillaris*; SEMC – **Minnesota** • 1♀; Traverse; [45.8032° N, 96.8352° W]; 14 Sep. 1938; Milliron H.E. leg.; UMSP • 1♀; Yellow Medicine, Antelope Valley SNA; 44.6784° N, 96.1196° W; 26 Aug. 2015; Jokela K. leg.; ex *Grindelia* sp.; MNDNR • 1♀; same location as preceding; 26 Aug. 2015; Jokela K. leg.; MNDNR – **Montana** • 1♀; Chouteau, Big Sandy; 48.0251° N, 110.0341° W; 05 Aug. 2015; Adhikari S. leg.; MTEC • 1♀; Gallatin, Gallatin Grown; 45.7713° N, 111.2953° W; 22 Aug. 2013; Delphia C.M. leg.; MTEC • 1♀; same location as preceding; 22 Aug. 2013; Delphia C.M. leg.; ex *Helianthus maximiliani*; MTEC • 1♀; same location as preceding; 11 Sep. 2013; Delphia C.M. leg.; ex *Heterotheca villosa*; MTEC • 2♀♀; Meagher, Tenderfoot Creek Experimental Forest; 46.9258° N, 110.8919° W; elev. 2147-2297 m.; 2001; Fultz J.E., O'Niell K.M. leg.; MTEC • 1♀; Musselshell, Roundup; [46.4452° N, 108.5418° W]; 03 Sep. 1924; Seamans H.L. leg.; CNC • 1♀; Pondera, Shelby (23 mi. S); [48.1854° N, 111.8754° W]; 16 Sep. 1964; Schuh J., Peters W.C. leg.; AMNH • 2♀♀; Pondera; [48.2322° N, 112.2886° W]; 20 Aug. 1926; MTEC • 2♀♀; Richmond, Berry Farm Restoration; 47.8631° N, 104.2504° W; 04 Sep. 2020; Cuminale A.W. leg.; ex *Grindelia squarrosa*; MTEC • 1♀, 1♂; Yellowstone, Pompey's Pillar; [45.9914° N, 107.9521° W]; 09 Aug. 1962; Rozen J.G., Rozen B.L. leg.; AMNH – **Nebraska** • 1♀; Dawes, Oglala National Grassland; 42.9073° N, 103.4457° W; elev. 1036 m.; 05 Sep. 1999; Hicks A.L., Scott V. leg.; UCMC – **North Dakota** • 1♀; Barnes, Rogers (10.7 km NE); 47.1129° N, 98.067° W; 10 Sep. 2012; Evans E. leg.; ex *Symphyotrichum* ericoides; MNDNR • 1♀; Barnes, Rogers (3.3 km NNE); 47.1031° N, 98.1933° W; 11 Sep. 2012; Evans E. leg.; MNDNR • 1♂; Burleigh, Bismarck; [46.8083° N, 100.7837° W]; 06 Aug. 1913; Stevens O.A. leg.; ex *Grindelia squarrosa*; AMNH • 1♂; Burleigh, McKenzie; [46.8242° N, 100.4134° W]; 05 Aug. 1913; Stevens O.A. leg.; ex *Grindelia squarrosa*; UKIC • 1♂; Cass, Fargo; [46.8772° N, 96.7898° W]; 10 Aug. 1912; Stevens O.A.

leg.; ex *Grindelia squarrosa*; AMNH • 1♂; same location as preceding; 24 Aug. 1912; Stevens O.A. leg.; ex *Grindelia squarrosa*; AMNH • 1♂; same location as preceding; 04 Sep. 1912; Stevens O.A. leg.; ex *Grindelia squarrosa*; AMNH • 1♂; same location as preceding; 04 Aug. 1910; Stevens O.A. leg.; ex *Grindelia squarrosa*; AMNH • 1♂; same location as preceding; 16 Aug. 1917; Stevens O.A. leg.; ex *Grindelia squarrosa*; AMNH • 1♀; same location as preceding; 21 Sep. 1911; Stevens O.A. leg.; ex *Callistephus chinensis*; AMNH • 1♀; same location as preceding; 22 Sep. 1911; Stevens O.A. leg.; ex *Symphyotrichum lanceolatum* var. *lanceolatum*; AMNH • 1♀; same location as preceding; 21 Aug. 1912; Stevens O.A. leg.; ex *Grindelia squarrosa*; AMNH • 1♀; same location as preceding; 14 Aug. 1910; Stevens O.A. leg.; ex *Grindelia squarrosa*; AMNH • 1♀; Golden Valley, Sentinel Butte; [46.9183° N, 103.8388° W]; 29 Aug. 1914; Stevens O.A. leg.; ex *Grindelia squarrosa*; CUIC • 1♂; same location as preceding; 29 Aug. 1914; Stevens O.A. leg.; ex *Grindelia squarrosa*; CUIC • 1♀, 1♂; same location as preceding; 29 Aug. 1914; Stevens O.A. leg.; ex *Grindelia squarrosa*; AMNH • 1♂; Grand Forks, Grand Forks; [47.9253° N, 97.0329° W]; 19 Aug. 1917; Fattig P.W. leg.; CUIC • 1♂; same location as preceding; 03 Aug. 1912; Stevens O.A. leg.; ex *Grindelia squarrosa*; AMNH • 2♀♀; Kidder, Steele; [46.8547° N, 99.9159° W]; 10 Sep. 1920; Stevens O.A. leg.; ex *Grindelia squarrosa*; AMNH • 2♂♂; Morton, Glen Ullin (10 mi. E); [46.8187° N, 101.6201° W]; 07 Aug. 1962; Rozen J.G., Rozen B.L. leg.; AMNH • 1♀; Ramsey, Devils Lake; [48.1122° N, 98.876° W]; 20 Aug. 1913; Stevens O.A. leg.; ex *Grindelia squarrosa*; UKIC • 1♀, 1♂; Stark, Dickinson; [46.8792° N, 102.7896° W]; 25 Aug. 1912; Waldron C.H. leg.; ex *Helianthus petiolaris*; AMNH • 1♀; Stutsman, Pingree (7.3 km N); 47.2258° N, 98.9096° W; 10 Sep. 2010; Evans E. leg.; MNDNR • 1♀; Towner, Perth; [48.7164° N, 99.4579° W]; 20 Aug. 1913; Stevens O.A. leg.; ex *Grindelia squarrosa*; AMNH • 1♀; Ward, Minot; [48.233° N, 101.2923° W]; 22

Aug. 1915; Stevens O.A. leg.; ex *Grindelia squarrosa*; AMNH • 1♀; Williams, Williston; [48.147° N, 103.618° W]; 15 Aug. 1915; Stevens O.A. leg.; ex *Grindelia squarrosa*; AMNH – **South Dakota** • 1♀; Custer, FS Rd 282; 43.805° N, 103.8322° W; 12 Sep. 2011; Drons D. leg.; SMIC • 1♀; Fall River, Hot Springs; [43.4316° N, 103.4744° W]; elev. 1067 m.; 01 Sep. 1951; Bryant O. leg.; CAS • 1♂; Jackson; 23 Aug. 2010; BIML • 1♀, 1♂; Pennington, Badlands National Monument (Park); [43.8° N, 102.4° W]; 26 Jun. 1972; Wolf S. leg.; WIRC • 4♂♂; same location as preceding; 24 Jun. 1972; Wolf S. leg.; WIRC • 4♂♂; same location as preceding; 20 Jun. 1972; Wolf S. leg.; WIRC • 1♂; Pennington, Badlands National Monument (Park), Sheep Mountain; [43.7° N, 102.6° W]; 26 Jun. 1972; Wolf S. leg.; WIRC • 1♂; Pennington, Badlands National Monument (Park), Sage Creek; [43.89° N, 102.41° W]; 26 Jun. 1972; Wolf S. leg.; WIRC • 2♀♀; Pennington; [43.7848° N, 102.1817° W]; 19 Sep. 2011; BIML • 1♂; Pennington; [43.7339° N, 101.9391° W]; 03 Sep. 2011; Devalez J. leg.; BIML • 1♀; Cottonwood; [43.97° N, 101.91° W]; 21 Jul. 1950; Severin H.C. leg.; SMIC • 1♂; same location as preceding; 24 Jun. 1950; Severin H.C. leg.; SMIC – **Utah** • 1♂; Daggett, Manila; [40.988° N, 109.7226° W]; 15 Aug. 1962; Knowlton G.F. leg.; ex *Chrysothamnus* sp.; SEMC • 1♀; Garfield, Middle Bench (1.65 mi. N); [37.5981° N, 111.9436° W]; 02 Aug. 2003; Johannsen A. leg.; ex Asteraceae sp.; BBSL • 1♀; Garfield, Middle Bench (2.86 mi. NNW); [37.611° N, 111.9662° W]; 22 Aug. 2003; Johannsen A. leg.; ex *Grindelia squarrosa*; BBSL • 2♀♀; same location as preceding; 22 Aug. 2003; Highbee S. leg.; ex *Grindelia squarrosa*; BBSL • 2♀♀; same location as preceding; 22 Aug. 2003; Johannsen A. leg.; ex *Grindelia squarrosa*; BBSL • 1♀; same location as preceding; 22 Aug. 2003; Johannsen A. leg.; ex *Helianthus petiolaris*; BBSL • 1♀; same location as preceding; 22 Aug. 2003; Ikerd H. leg.; ex *Helianthus* sp.; BBSL • 1♀; same location as preceding; 22 Aug. 2003; Highbee S. leg.; ex *Helianthus* sp.; BBSL • 1♀; Kane,

Grand Staircase-Escalante National Monument, Grosvenor Arch (0.32 mi. SE); [37.4539° N, 111.8267° W]; 12 Sep. 2003; Johannsen A. leg.; BBSL • 2♀♀; Kane, Grand Staircase-Escalante National Monument, Round Valley Seep (1.87 mi. NNE); [37.4783° N, 111.8942° W]; 12 Sep. 2003; Highbee S. leg.; ex *Helianthus annuus*; BBSL • 1♀; same location as preceding; 12 Sep. 2003; Hansen B. leg.; ex *Helianthus annuus*; BBSL • 1♀; Kane, Mouth of Lick Wash (1.13 mi. W); [37.3225° N, 112.1581° W]; 10 Sep. 2003; Johannsen A. leg.; ex *Gutierrezia sarothrae*; BBSL • 1♀; Kane, Slide Canyon, Slide Canyon (2.14 mi. E); [37.2945° N, 112.1816° W]; 10 Sep. 2003; Tolliver J. leg.; ex *Symphyotrichum chilense*; BBSL • 1♂; Uintah, Vernal; [40.4555° N, 109.5287° W]; 24 Jun. 1950; Michener C.D. leg.; ex *Chaenactis stevioides*; SEMC • 1♀; Washington, Wildcat Canyon; [37.3534° N, 113.0488° W]; 07 Sep. 1954; Knowlton G.F. leg.; ex *Ericameria nauseosa* var. *nauseosa*; SEMC – **Wyoming** • 1♀; Sheridan, Metz; [44.7879° N, 106.926° W]; AMNH

Description

Male:

Structure: Body length range 5.03–6.43 mm. Head broader than long (HL/HW ratio 0.91). Face below antennae flat. Labral process trapezoidal, broader than long, apex truncate. Clypeus with median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.27). Posterior ocelli 0.31 mm apart. Flagellomeres broader than long. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.08 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.13 mm. S6 notch deep, extending approximately 1/2 of disk, lateral carina absent.

Sculpture: Clypeus punctation fine and dense (IS < 1 PD). Paraocular punctation fine and dense (IS < 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea clavate. Foveae converging above, narrow end terminating in line with dorsal tangent of antennal socket. Frons finely reticulate. Vertex punctation fine and dense (IS < 1 PD). Mesoscutum punctation coarse and dense (IS < 1 PD). Scutellum punctation coarse and dense (IS < 1 PD). Mesopleuron punctation fine and dense (IS < 1 PD). Lateral propodeum finely reticulate. Posterior propodeum finely reticulate. Posterior propodeum tessellate. Dorsal face of T1 punctation fine and dense (IS < 1 PD). T2 basal impression deep, approximately 1/2 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus yellow. Supraclypeal area yellow to within 0.5 MOD of antennal socket. Lower paraocular area yellow reaching ventral tangent of antennal socket medially, narrowly extending along compound eye terminating in line with dorsal tangent of antennal socket. Labral process yellow. Mandible yellow. Scape yellow anteriorly. Flagellomeres F1-F10 yellow ventrally. Pronotal lobe black. Tegula yellow. Wing veins and stigma light brown, membrane light brown. Fore tibia yellow anteriorly dark posteriorly, mid and hind tibia with reduced dark spot medially, yellow apically and basally. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, yellow/brown. Scutellum pilosity medium-length, yellow/brown. Mesopleuron pilosity long, white. Sternite pubescence colour yellow. S3 pubescence medium-length, sparse. S4 pubescence medium-length, sparse. S5 pubescence medium-length, medially directed apicolateral fringes.

Female:

Structure: Body length range 5.5–6.96 mm. Head broader than long (HL/HW ratio 0.86). Face below antennae flat. Labral process rectangular, broader than long, apex rounded. Clypeus without median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.07). Posterior ocelli 0.35 mm apart. Flagellomeres broader than long. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.3 mm. Metapostnotum weakly extended medially <25% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.063 mm.

Sculpture: Clypeus punctation fine and dense (IS < 1 PD). Paraocular punctation fine and dense (IS < 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 1/2 way down antennal socket. Frons finely reticulate. Vertex punctation fine and dense (IS < 1 PD). Mesoscutum punctation fine and dense (IS < 1 PD). Scutellum punctation fine and dense (IS < 1 PD). Mesopleuron punctation fine and dense (IS < 1 PD). Lateral propodeum finely reticulate. Posterior propodeum finely reticulate. Posterior propodeum tessellate. Dorsal face of T1 punctation fine and sparse (IS > 1 PD). T2 basal impression shallow, approximately 1/3 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus with yellow extending along dorsal border and medially. Supraclypeal area yellow to within 1.5 MOD of antennal socket. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F3-F10 yellow ventrally. Pronotal lobe black. Tegula yellow. Wing veins and stigma light brown, membrane light brown. Fore and mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi orange.

Pubescence: Mesoscutum pilosity short, yellow. Scutellum pilosity medium-length, yellow. Mesopleuron pilosity long, white. Sternite pubescence colour yellow. S3 pubescence medium-

length, sparse. S4 pubescence medium-length, sparse. S5 pubescence medium-length, medially directed apicolateral fringes.

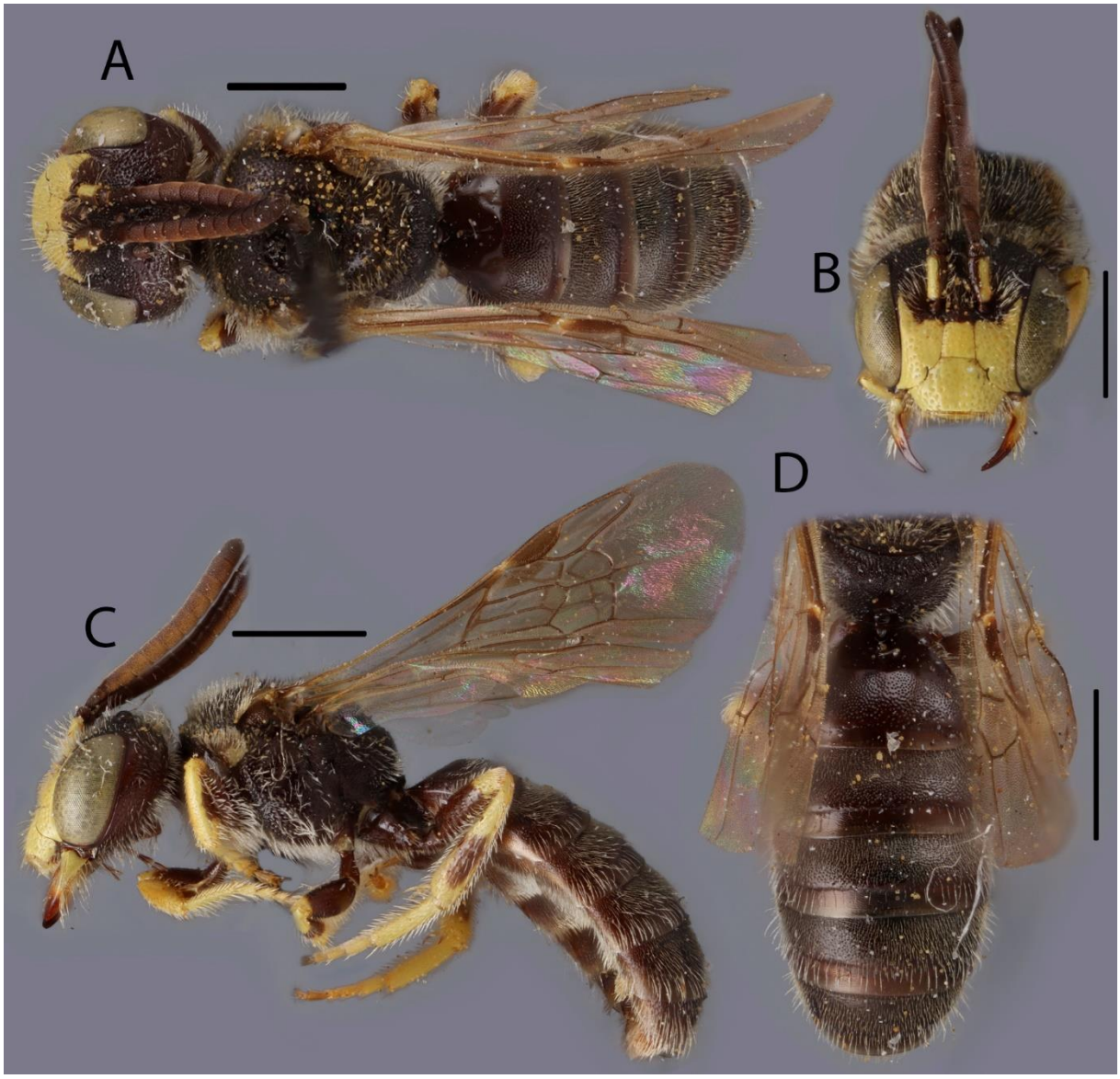


Figure 103. *Protandrena* (*Pterosarus*) *renimaculata*, ♂. AMNH_00176846. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

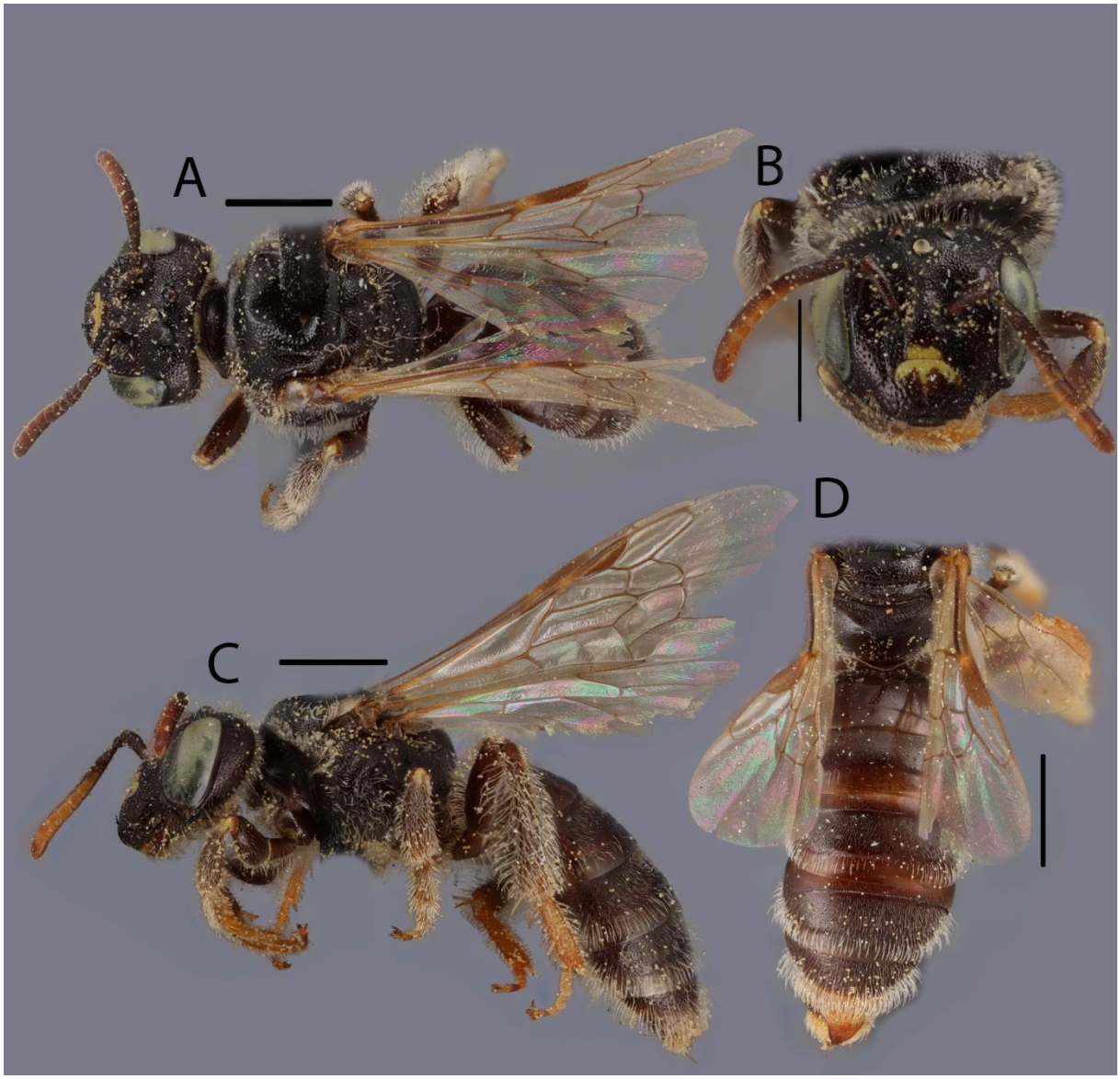


Figure 104. *Protandrena* (*Pterosarus*) *renimaculata*, ♀. UCMC_221286. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena renimaculata* is active from late June to late September. Most floral records are from the tribe Astereae, with specific preference for the genus *Grindelia*.

Range: Canada (Alberta, Manitoba, Saskatchewan), USA (Colorado, Kansas, Minnesota, Montana, Nebraska, North Dakota, Texas, Utah, Wyoming).

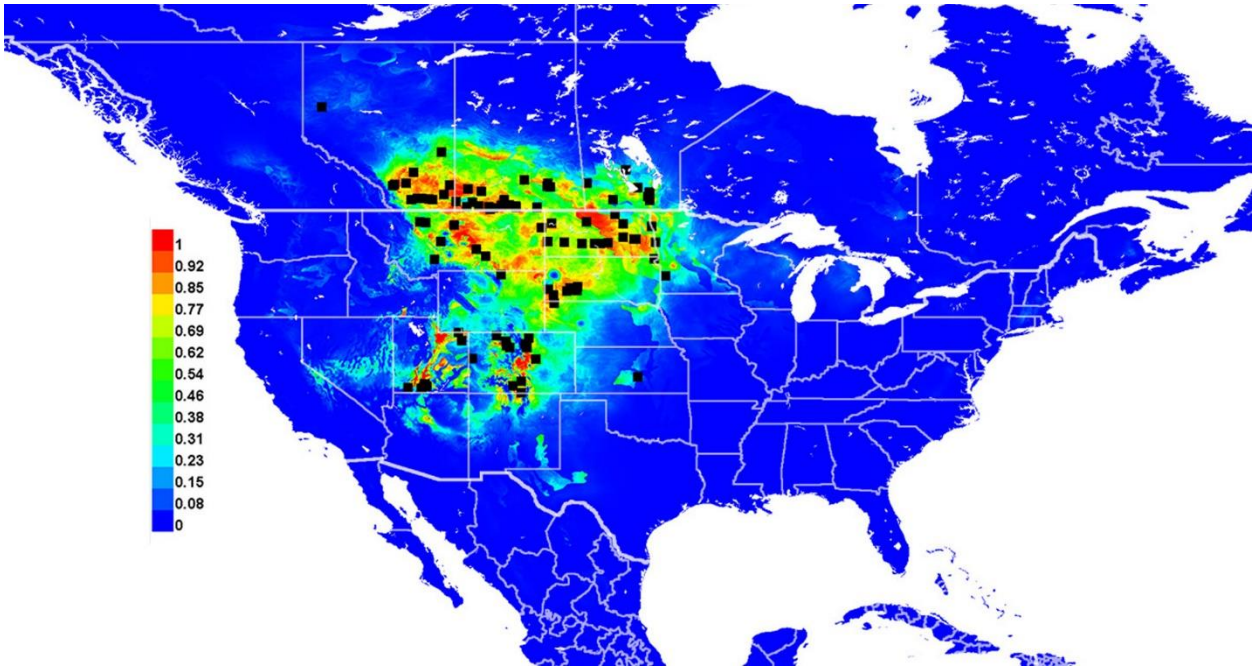


Figure 105. Georeferenced collection records of *Protandrena* (*Pterosarus*) *renimaculata* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *rowellae* new species**

(Figure 106)

Holotype: ♂ USA – New Mexico • Grant, Hachita (12.6 mi W); 31.965° N, 108.611111° W; elev. 1440 m.; 27 Sep. 1999; Brooks R., Michener C. leg.; ex *Heliomeris multiflora* nevadensis; SEMC. SMO150712

Etymology

The specific epithet *rowellae* is formed from the last name of the Biology Lab Coordinator at Algoma University Shannon Rowell-Garvon.

Diagnosis:

Males of *Pr*. (*Pt*.) *rowellae* can be recognized by a combination of their finely reticulate posterior face of propodeum (contrast all except: *albipes bilobata citrinifrons didirupa luxsolaris occidua ornatipes prata planafacialis quadrapylae renimaculata ehnesae*), yellow pronotal lobes (contrast albipes luxsolaris prata) and inflated tarsi (contrast remaining).

Material examined:

USA – **Arizona** • 1♂; Cochise, Apache; [31.6904° N, 109.1323° W]; 24 Sep. 1984; Rozen J.G. leg.; AMNH– **New Mexico** • 5♂♂; Grant, Hachita (12.6 mi W); 31.965° N, 108.6111° W; elev. 1440 m.; 27 Sep. 1999; Brooks R., Michener C. leg.; ex *Heliomeris multiflora nevadensis*; SEMC

• 3♂♂; Grant, Hachita (0.25 mi N); 31.9158° N, 108.3227° W; elev. 1440 m.; 27 Sep. 1999; Brooks R., Michener C. leg.; ex *Heliomeris multiflora* nevadensis; SEMC

Description

Male:

Structure: Body length range 5.27–6.18 mm. Head broader than long (HL/HW ratio 0.84). Face below antennae convex. Labral process quadrate, about equal, apex emarginate. Clypeus without median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.35). Posterior ocelli 0.30 mm apart. Flagellomeres longer than broad. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.11 mm. Metapostnotum weakly extended medially <25% way to propodeal pit. Tarsi 2–4 inflated. Fore tarsi width 0.2 mm. S6 notch deep, extending approximately 1/2 of disk, lateral carina absent.

Sculpture: Clypeus punctation fine and sparse (IS = 1 PD). Paraocular punctation fine and dense (IS < 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 1 MOD from dorsal tangent of antennal socket. Frons finely reticulate. Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation fine and sparse (IS > 1 PD). Scutellum punctation fine and sparse laterally (IS > 1 PD) denser medially (IS < 1 PD). Mesopleuron punctation fine and sparse (IS = 1 PD). Lateral propodeum finely reticulate. Posterior propodeum finely reticulate. Posterior propodeum not microsculptured. Dorsal face of T1 punctation fine and dense (IS < 1 PD) impunctate medially. T2 basal impression deep, approximately 1/2 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation sparse (IS = 1 PD).

Colour: Clypeus yellow. Supraclypeal area yellow in line with ventral tangent of antennal socket. Lower paraocular area yellow forming straight line with supraclypeal mark reaching ventral tangent of antennal socket. Labral process yellow. Mandible yellow. Scape yellow anteriorly. Flagellomeres F3-F11 yellow ventrally. Pronotal lobe yellow. Tegula brown. Wing veins and stigma brown, membrane hyaline. Fore tibia yellow anteriorly dark posteriorly, mid and hind tibia yellow apically and basally. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity medium-length, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium-length, dense. S4 pubescence medium-length, dense. S5 pubescence medium-length, dense.

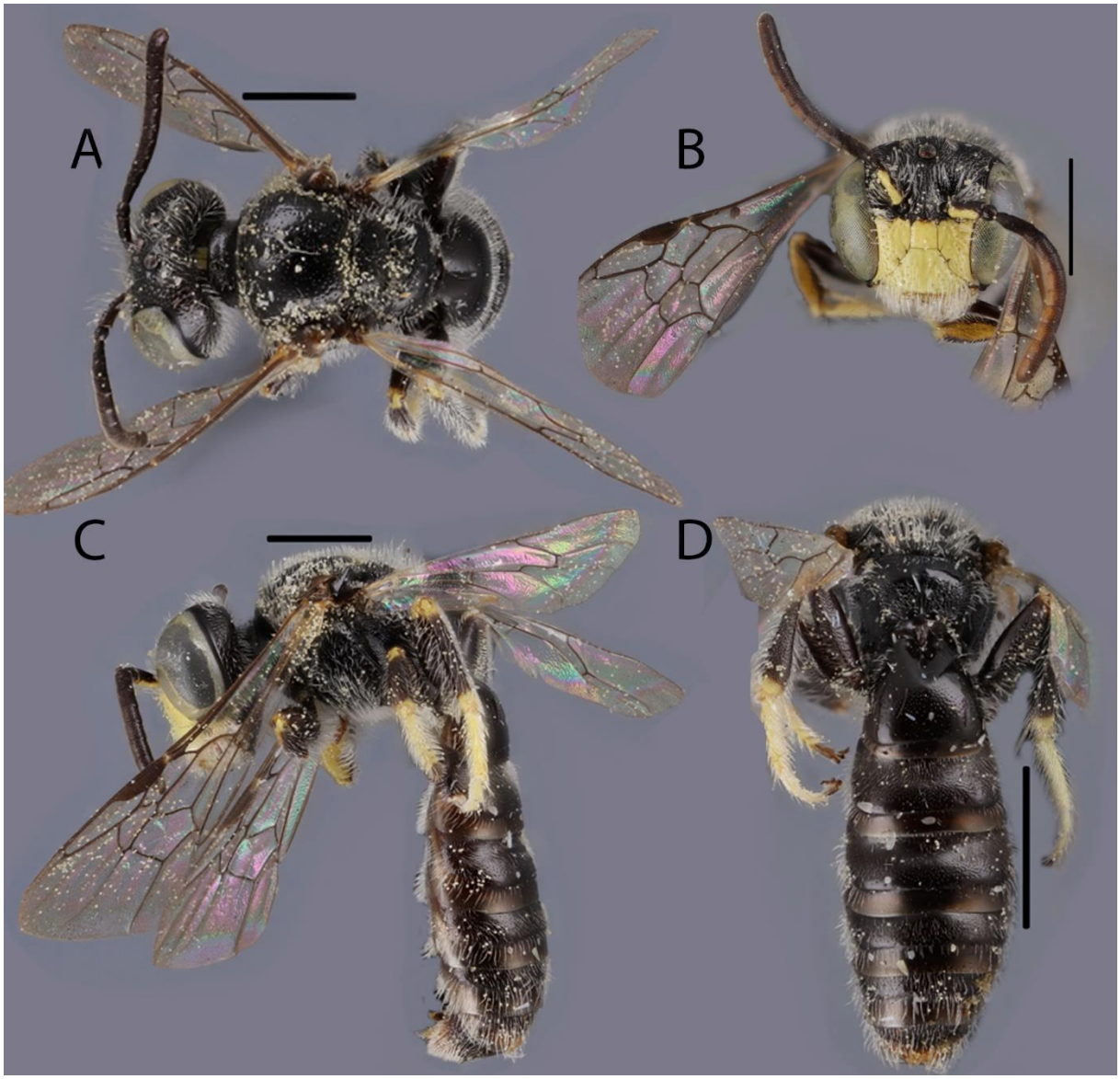


Figure 106. *Protandrena* (*Pterosarus*) *rowellae*, ♂. SEMC_150712. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena rowellae* is active in September. All floral records for the species are males collected on *Heliomeris multiflora* var. *nevadensis*.

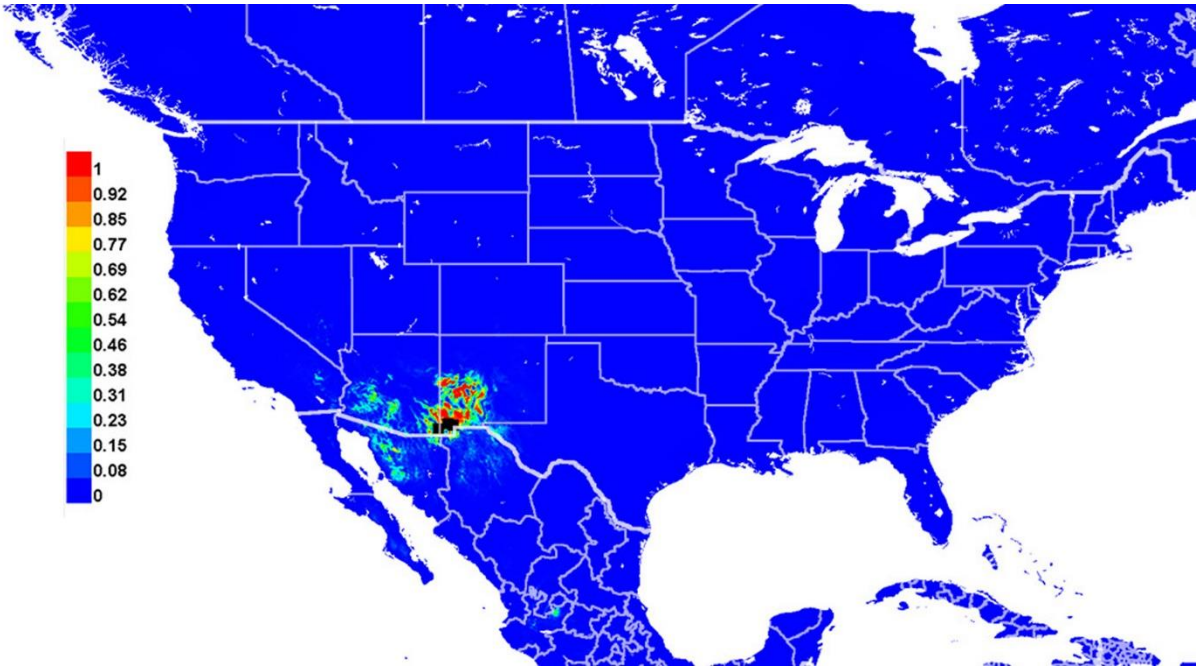


Figure 107. Georeferenced collection records of *Protandrena* (*Pterosarus*) *rowellae* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *rudbeckiae* (Robertson)**

(Figure 108, Figure 109)

Calliopsis rudbeckiae Robertson, 1895: 122. ♀♂ Lectotype ♀ INHS: 179552 designation by W. E. LaBerge in Webb (1980). Type locality: USA; Illinois, Macoupin Co., Carlinville (Robertson 1928). Examined specimen.

Taxonomy: Cockerell, 1912: 447 (comparison with *P. labrosiformis distractus*). – Mitchell, 1960: 279–280 (redescription).

Type specimens: Robertson (1895) described *Calliopsis rudbeckiae* from 42 male and 23 female syntypes. W.E. LaBerge in Webb (1980) designated a female specimen at the INHS as the name bearing lectotype.

Diagnosis:

Males of *Pr*. (*Pt*.) *rudbeckiae* can be recognized by a combination of their rugose posterior face of propodeum (contrast all except: *Pr*. *aestivalis* , *Pr*. *albertensis, Pr*. *albitarsis, Pr*. *alveus, Pr*. *andrenoides, Pr*. *californica, Pr*. *chepesepe, Pr*. *citripes, Pr*. *compositarum, Pr*. *leucoptera, Pr*. *piercei, Pr*. *skeggox, Pr*. *solidaginis, Pr*. *vicina, Pr*. *vigvierae*), scutum punctures denser anteriorly sparser posteriorly (contrast *Pr*. *aestivalis , Pr*. *albitarsis, Pr*. *alveus, Pr*. *andrenoides, Pr*. *californica, Pr*. *chepesepe, Pr*. *citripes, Pr*. *compositarum, Pr*. *leucoptera, Pr*. *piercei, Pr*. *skeggox, Pr*. *solidaginis, Pr*. *vicina, Pr*. *vigvierae*) and face flattened below antennae (contrast *Pr*. *albertensis*).

Females of *Pr*. (*Pt*.) *rudbeckiae* can be recognized by a combination of their conically produced prosternum (contrast all except: *Pr*. *lutzae, Pr*. *piercei, Pr*. *ehnesae*), finely reticulate posterior face of propodeum (contrast *Pr*. *piercei, Pr*. *ehnesae*) and scutum uniformly punctate (contrast *Pr*. *lutzae*).

Material examined:

USA – **Arkansas** • 1♂; Johnson, Clarksville (8 mi N); [35.576° N, 93.4766° W]; 01 Jul. 1989; Brown R.L. leg.; ex *Coreopsis* sp.; MEM – **Illinois** • 2♀♀, 1♂♂; Macoupin, Carlinville; [39.2798° N, 89.8818° W]; 19 Aug. 1970; Marlin J.C. leg.; ex *Rudbeckia triloba*; INHS • 1♀; same location as preceding; 01 Aug. 1901; Robertson C. leg.; INHS • 21♀♀, 40♂♂; same

location as preceding; Robertson C. leg.; INHS • 1♂; same location as preceding; 1898; Robertson C. leg.; INHS – **Indiana** • 1♀; Putnam, DePauw University; [39.64° N, 86.86° W]; 12 Aug. 1977; Johnson M.D. leg.; ex *Rudbeckia* sp.; RJPC • 1♂; Putnam, Rd 625W + 100S; [39.647° N, 86.96° W]; 17 Aug. 1979; Johnson M.D. leg.; RJPC • 1♂; Tippecanoe, Lafayette; [40.4167° N, 86.8753° W]; 26 Aug. 1961; Batra S. leg.; SEMC • 1♀; Vermilion, Clinton, 15050 South Willow Grove Ave.; [39.6655° N, 87.413° W]; 06 Aug. 2000; Jean R.P. leg.; ex *Rudbeckia* sp.; RJPC – **Iowa** • 1♀; Moseley; [42.3996° N, 92.4907° W]; 10 Aug. 2018; ex *Rudbeckia triloba*; UNI: AW – **Minnesota** • 2♀♀; Fillmore, Rushford; [43.7676° N, 91.6541° W]; 20 Aug. 2014; Leddy S. leg.; WRME – **Missouri** • 1♀, 1♂; Jefferson, Victoria Glades Conservation Area, Hillsboro (1.5 mi. SE); [38.2026° N, 90.5495° W]; 20 Jul. 1986; Arduser M. leg.; ex *Rudbeckia* missouriensis; MAPC • 1♂; Jefferson; [38.2767° N, 90.5534° W]; 28 Jul. 1985; Arduser M. leg.; ex *Rudbeckia* missouriensis; MAPC • 3♀♀, 2♂♂; Laclede, Lebanon; [37.6806° N, 92.6638° W]; 20 Aug. 1953; Michener C.D. leg.; SEMC • 1♂; same location as preceding; 06 Aug. 1951; Michener C.D. leg.; ex *Rudbeckia hirta*; SEMC • 1♂; Montgomery, Danville Conservation Area; [38.8653° N, 91.5048° W]; 15 Aug. 2003; Arduser M. leg.; MAPC • 1♀; Phelps, Beaver Creek; [37.8951° N, 91.8361° W]; 21 Aug. 1962; Vogel B. leg.; UCMC • 1♀, 1♂; Reynolds, Johnson's Shut-Ins State Park; 37.556° N, 90.8392° W; 12 Aug. 2017; Arduser M. leg.; ex *Rudbeckia triloba*; MAPC • 1♂; St. Francois, St. Joe State Park (NW corner); [37.8073° N, 90.5055° W]; 18 Aug. 1989; Arduser M. leg.; ex *Rudbeckia* missouriensis; MAPC – **Nebraska** • 1♀; Lancaster, Lincoln; 40.8146° N, 96.6886° W; elev. 366 m.; Aug.; Swenk leg.; UCMC

Description

Male:

Structure: Body length range 5.18–6.35 mm. Head broader than long (HL/HW ratio 0.85). Face below antennae flat. Labral process trapezoidal, broader than long, apex emarginate. Clypeus with median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.34). Posterior ocelli 0.25 mm apart. Flagellomeres longer than broad. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.06 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.14 mm. S6 notch deep, extending approximately 1/2 of disk, lateral carina absent.

Sculpture: Clypeus punctation mixed in size, absent medially, dense laterally (IS < 0.5 PD). Paraocular punctation coarse and dense (IS = 0.5 PD). Supraclypeal area punctation mixed in size, sparse (IS > 3 PD). Fovea clavate. Foveae converging above, narrow end terminating slightly above antennal socket. Frons punctation reticulate. Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation fine and dense anteriorly (IS < 0.5 PD) sparser posteriorly (IS = 1 – 2 PD). Scutellum punctation coarse and sparse (IS > 2 PD) denser medially (IS < 1 PD) reticulate anteriorly. Mesopleuron punctation fine and sparse (IS = 1 PD). Lateral propodeum punctation reticulate. Posterior propodeum rugose. Posterior propodeum tessellate. Dorsal face of T1 punctation fine and dense (IS < 1 PD) impunctate medially. T2 basal impression deep, approximately 1/2 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus yellow. Supraclypeal area with large roughly triangular yellow mark, terminating in line with paraocular mark. Lower paraocular area yellow 1 MOD below dorsal margin of clypeus, and extend diagonally to 1 MOD below antennal socket along compound eye.

Labral process yellow. Mandible yellow. Scape black. Flagellomeres F3-F9 orange ventrally. Pronotal lobe yellow. Tegula light brown. Wing veins and stigma brown, membrane hyaline. Fore tibia yellow anteriorly dark posteriorly, mid and hind tibia yellow at knee, extending 1/4 down tibia before becoming entirely dark. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, yellow. Scutellum pilosity of two forms long and medium-length, yellow. Mesopleuron pilosity short, white. Sternite pubescence colour yellow. S3 pubescence short, sparse. S4 pubescence medium length, sparse, with medially directed apicolateral fringes. S5 pubescence long, medially directed apicolateral fringes.

Female:

Structure: Body length range 6.07–7 mm. Head broader than long (HL/HW ratio 0.8). Face below antennae convex. Labral process trapezoidal, broader than long, apex truncate. Clypeus without median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.07). Posterior ocelli 0.29 mm apart. Flagellomeres slightly broader than long. Dorsal pronotal carina extends laterally to pronotal lobes. Prosternum conically produced. ITD 1.34 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.063 mm.

Sculpture: Clypeus punctation fine and sparse medially (IS > 4 PD) denser laterally (IS < 1 PD). Paraocular punctation fine and sparse (IS = 1 – 4 PD). Supraclypeal area punctation fine and sparse (IS > 4 PD). Fovea clavate. Foveae converging above, narrow end terminating in line with antennal socket. Frons punctation fine and dense (IS < 1 PD). Vertex punctation coarse and sparse (IS = 1 PD). Mesoscutum punctation minute and sparse (IS = 1 PD). Scutellum punctation fine and sparse (IS > 3 PD) denser medially (IS = 1 PD). Mesopleuron punctation fine and sparse

(IS > 1 PD). Lateral propodeum punctation fine and dense (IS < 1 PD). Posterior propodeum finely reticulate. Posterior propodeum not microsculptured. Dorsal face of T1 punctation very minute and sparse (IS > 10 PD). T2 basal impression shallow, approximately 1/2 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation sparse (IS = 1 PD).

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F4-F9 orange ventrally. Pronotal lobe black. Tegula yellow. Wing veins and stigma brown, membrane hyaline. Fore and mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity medium-length, yellow. Scutellum pilosity of two forms long and short, yellow. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence short, sparse. S4 pubescence short, sparse. S5 pubescence long, medially directed apicolateral fringes.

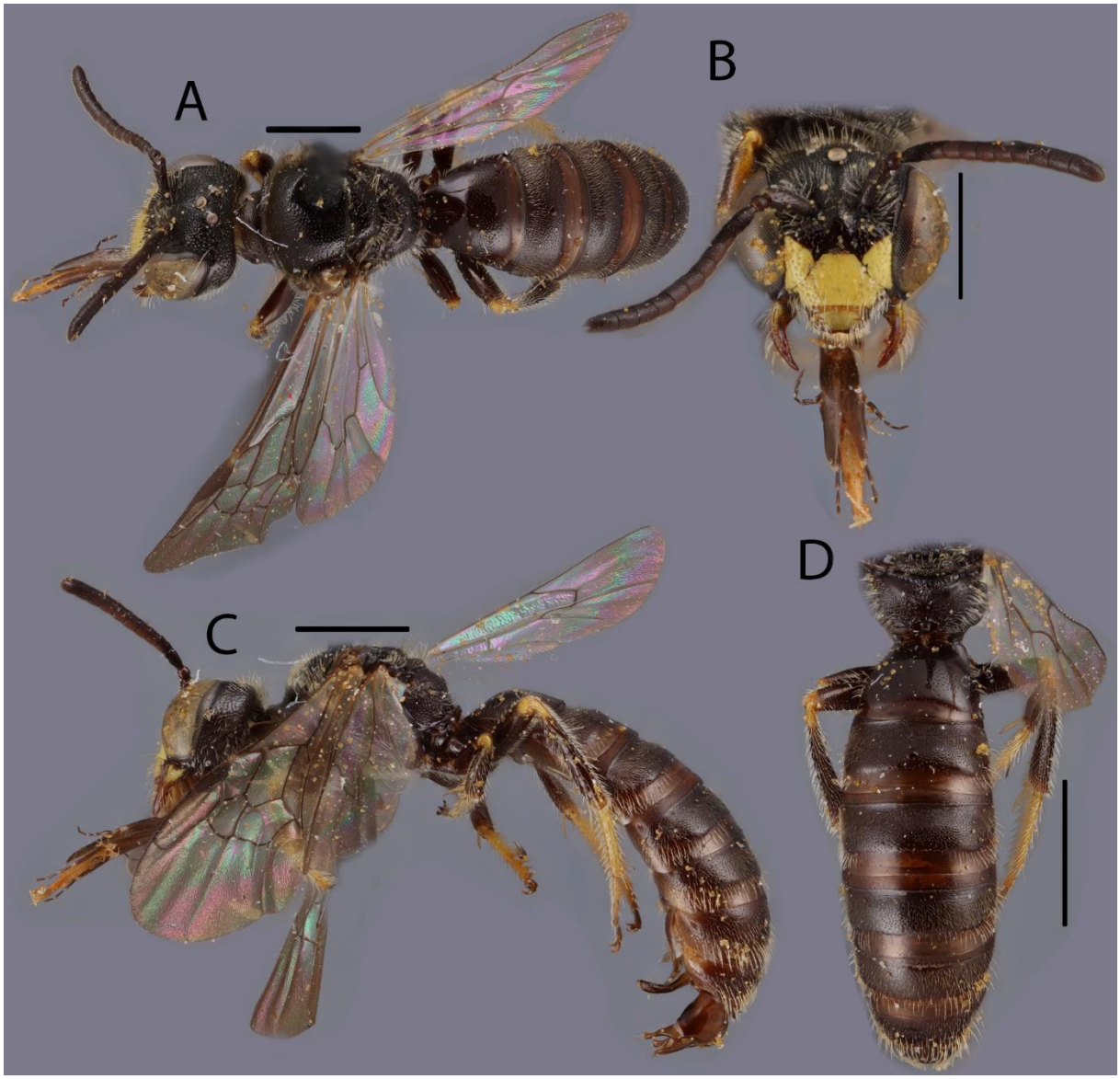


Figure 108. *Protandrena* (*Pterosarus*) *rudbeckiae*, ♂. MAPC. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

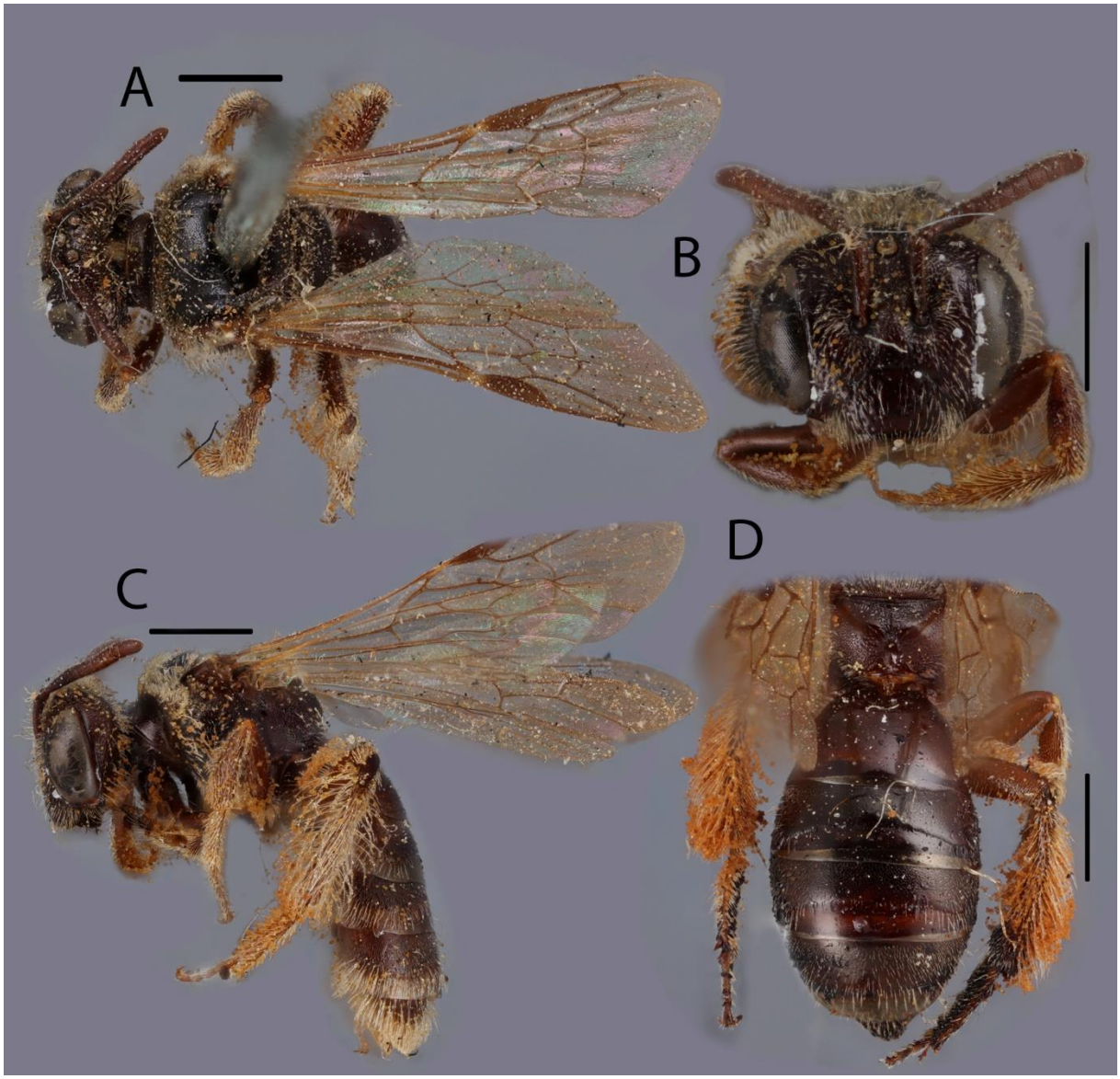


Figure 109. *Protandrena* (*Pterosarus*) *rudbeckiae*, ♀. INHS. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological Notes: *Protandrena rudbeckiae* is active from mid-July to late September. Kathirithamby and Taylor (2005) recorded the parasite of *Protandrena rudbeckiae* as *Crawfordia pulvinipes*. Most floral records for the species are in the tribe Heliantheae, with

specific preference for the genus *Rudbeckia*, however, Robertson (1922) notes a female collecting pollen from *Bidens aristosa*.

Range: USA (Arkansas, Illinois, Indiana, Iowa, Maryland, Minnesota, Missouri, Nebraska, [Wisconsin]).

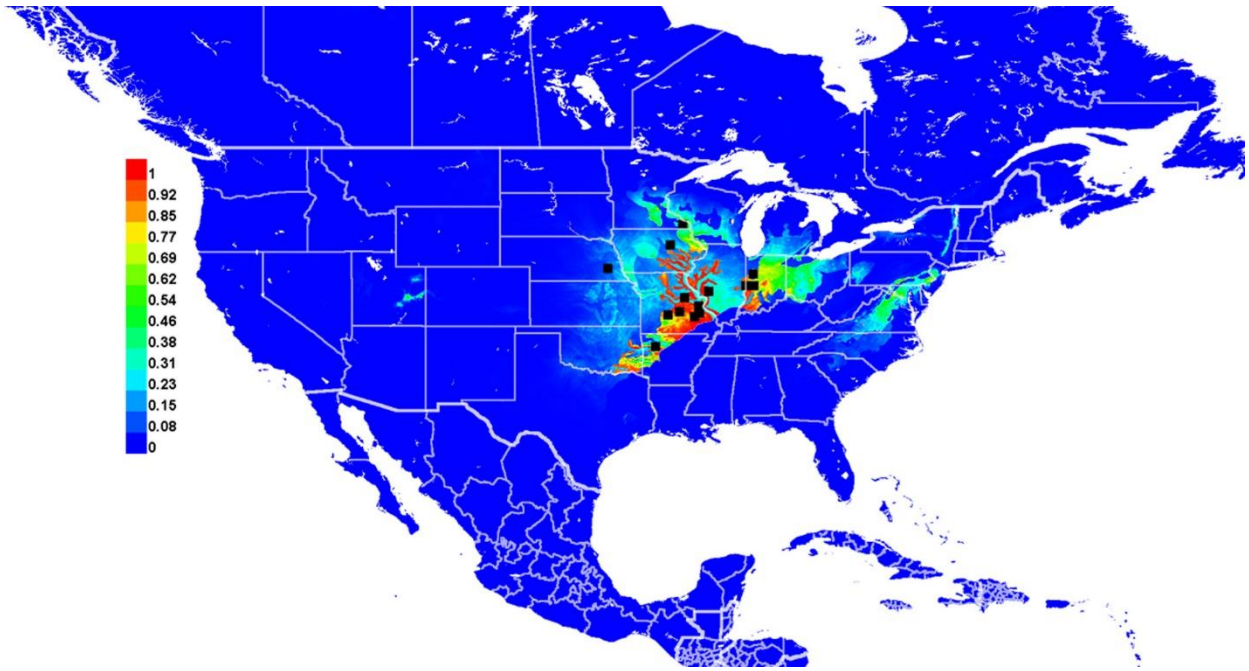


Figure 110. Georeferenced collection records of *Protandrena* (*Pterosarus*) *rudbeckiae* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *skeggox* new species**

(Figure 111)

Holotype: ♂ USA - New Mexico • Luna, Deming (17 mi. E); [32.251315° N, 107.469607° W]; 17 Sep. 1966; Rust R., Torchio P., Wood G., Yousef N. leg.; ex *Adenophyllum glandulosum*; SEMC. SMO287492

Etymology:

The specific epithet *skeggox* is from the Norse noun skeggox (‘bearded axe’) for the shape of the fore tarsi in males and their resemblance to the head of a bearded axe.

Diagnosis:

Males of *Pr*. (*Pt*.) *skeggox* can be recognized by their full yellow maculations on the face that extend past antennal sockets laterally (contrast all except: *Pr. aurifodinae, Pr. bilobata*, *Pr. boylei*), and their Tarsi 2–4 inflated to one side (contrast remaining).

Material examined:

USA – **New Mexico** • 1♂; Luna, Deming (17 mi. E); [32.25015° N, 107.467717° W]; 17 Sep. 1966; Rust R., Torchin P., Wood G., Yousef N. leg.; ex *Thymophylla concinna*; AMNH

• 1♂; Luna, Deming (17 mi. E); [32.251315° N, 107.469607° W]; 17 Sep. 1966; Rust R., Torchio P., Wood G., Yousef N. leg.; ex *Adenophyllum glandulosum*; SEMC

• 1♂; Hidalgo, Rodeo (15 mi. N); [32.052716° N, 109.011727° W]; 17 Aug. 1974; Rozen J.G. leg.; AMNH

Description

Male:

Structure: Body length range 5.67–6.08 mm. Head broader than long (HL/HW ratio 0.8). Face below antennae convex. Labral process trapezoidal, broader than long, apex truncate. Clypeus without median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.32). Posterior ocelli 0.31 mm apart. Flagellomeres longer than broad. Dorsal pronotal carina

absent. Prosternum not produced. ITD 1.04 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 one side inflated. Fore tarsi width 0.21 mm. S6 notch shallow, less than 1/4 of disk, lateral carina absent.

Sculpture: Clypeus punctation fine and sparse (IS < 1 PD). Paraocular punctation fine and sparse (IS < 1 PD). Supraclypeal area punctation fine and sparse (IS < 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 0.5 MOD from dorsal tangent of antennal socket. Frons finely reticulate. Vertex punctation fine and sparse (IS = 1 PD). Mesoscutum punctation fine and sparse (IS > 1 PD). Scutellum punctation fine and sparse laterally (IS > 1 PD). Mesopleuron punctation fine and sparse posteriorly (IS = 1 PD) denser anteriorly (IS < 1 PD). Lateral propodeum finely reticulate. Posterior propodeum rugose. Posterior propodeum tessellate. Dorsal face of T1 punctation fine and dense (IS < 1 PD). T2 basal impression deep, approximately 1/2 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus yellow. Supraclypeal area yellow extending to ventral tangent of antennal sockets. Lower paraocular area yellow medially in line with ventral tangent of antennal sockets, extending in a rectangular shape along compound eye terminating in straight line 0.5 MOD from dorsal tangent of antennal socket. Labral process yellow. Mandible yellow. Scape yellow anteriorly. Flagellomeres F1-F8 yellow ventrally. Pronotal lobe yellow. Tegula yellow. Wing veins and stigma brown, membrane hyaline. Fore tibia yellow anteriorly dark posteriorly, mid and hind tibia with reduced dark spot medially, yellow apically and basally. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity long, white. Mesopleuron pilosity medium-length, white. Sternite pubescence colour white. S3 pubescence short, sparse. S4 pubescence short, sparse. S5 pubescence long, medially directed apicolateral fringes.

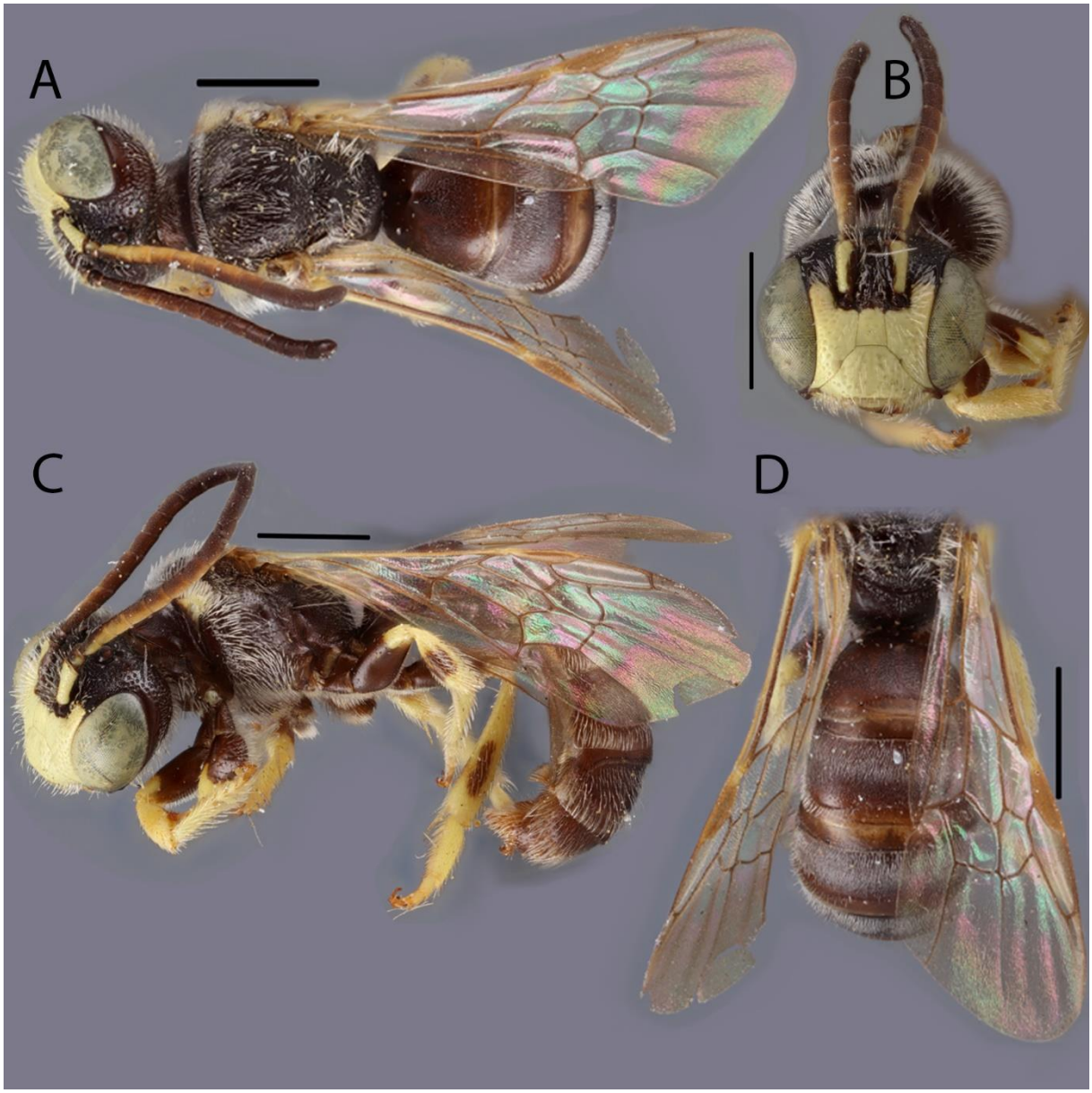


Figure 111. *Protandrena* (*Pterosarus*) *skeggox*, ♂. SEMC_287492. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

***Protandrena* (*Pterosarus*) *solidaginis* (Robertson)**

(Figure 112, Figure 113)

Calliopsis solidaginis Robertson, 1893: 274. ♀. Holotype ♀ INHS: 179555 by monotypy. Type locality: USA; Illinois, Macoupin Co., Carlinville (Robertson 1928). Examined specimen.

Taxonomy: Robertson, 1898: 50 ♂. – Mitchell, 1960: 280–281. (redescription). – Timberlake, 1967: 11–13 (Comparison with *didirupa* and *vicinus*).

Type specimens: Robertson (1893) described *Calliopsis solidaginis* from a single female.

Diagnosis:

Males of *Pr*. (*Pt*.) *solidaginis* can be recognized by a combination of their rugose posterior face of propodeum (contrast all except: *Pr. aestivalis, Pr. albertensis, Pr. albitarsis, Pr. alveus, Pr. andrenoides, Pr. californica, Pr. chepesepe, Pr. citripes, Pr. compositarum, Pr. leucoptera, Pr. piercei, Pr. rudbeckiae, Pr. skeggox, Pr. solidaginis, Pr. vicina, Pr. vigvierae*), dark pronotal lobes (contrast *Pr. aestivalis, Pr. albertensis, Pr. alveus, Pr. andrenoides, Pr. piercei, Pr. rudbeckiae, Pr. skeggox*), uniformly coarse and dense scutum punctures (contrast *Pr. albitarsis, Pr. californica, Pr. chepesepe, Pr. citripes, Pr. compositarum, Pr. leucoptera, Pr. vigvierae*) and yellow on underside of flagella (contrast *Pr. vicina*).

Females of *Pr*. (*Pt*.) *solidaginis* can be recognized by their scutum punctures that are reticulate anteriorly but sparser posteriorly (contrast all except *Pr. bidentis*), and broadly rectangular labral process (contrast *Pr. bidentis*).

Material examined:

USA – **Illinois** • 10♀♀, 14♂♂; Macoupin, Carlinville; [39.2798° N, 89.8818° W]; Robertson C. leg.; INHS • 2♀♀; same location as preceding; 13 Aug. 1897; Robertson C. leg.; INHS • 1♀; same location as preceding; 1898; Robertson C. leg.; INHS– **Kansas** • 1♀; Douglas; [38.9108° N, 95.2684° W]; 01 Sep. 1949; Michener C.D., Beamer leg.; ex *Bidens* polylepis; SEMC– **Louisiana** • 3♀♀; Tangipahoa, Sandy Hollow WMA - North; 30.8333° N, 90.4° W; 24 Oct. 2003; Prowell D., Bartholomew C. leg.; BBSL • 1♂; same location as preceding; 01 Oct. 2003; Prowell D., Bartholomew C. leg.; ex *Helianthus* sp.; BBSL– **Maryland** • 1♀; Prince Georges; [38.6919° N, 77.0697° W]; 30 Sep. 2003; Ibrahim M. leg.; BIML– **Mississippi** • 1♂; Lafayette, Oxford (10 mi. NW); [34.4239° N, 89.6621° W]; 17 Sep. 1976; Zuccaro A.E. leg.; MEM • 1♂; Webster, Eupora; [33.5463° N, 89.2901° W]; 17 Sep. 1983; Brown R.L. leg.; MEM– **Missouri** • 1♀; St. Clair, Schell Osage CA; [37.9836° N, 94.042° W]; 13 Sep. 2017; Jean R.P. leg.; ex *Bidens aristosa*; RJPC • 1♀, 1♂; St. Clair, Taberville Prairie Conservation Area, Taberville (3.8 mi N); [38.0397° N, 93.9765° W]; 13 Sep. 2006; Jean R.P. leg.; ex *Bidens* aritosa; MAPC • 1♀, 1♂; St. Clair, Wahkontah Prairie, T36N R28W Sec 3 (S1/2); [37.916° N, 94° W]; 12 Sep. 2007; Jean R.P. leg.; ex *Bidens aristosa*; RJPC– **Virginia** • 1♀; Augusta, George Washington National Forest, Maple Flats-Twin Ponds; [37.9827° N, 78.9963° W]; 31 Aug. 2016; Orcutt E.C. leg.; ex Helenium virginicum; BIML • 1♀; Prince William; [38.805° N, 77.572° W]; 19 Aug. 2012; Sherwood B. leg.; BIML

Description

Male:

Structure: Body length range 4.32–5.22 mm. Head broader than long (HL/HW ratio 0.91). Face below antennae convex. Labral process trapezoidal, broader than long, apex truncate. Clypeus

without median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.31). Posterior ocelli 0.28 mm apart. Flagellomeres broader than long. Dorsal pronotal carina absent. Prosternum not produced. ITD 0.95 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.11 mm. S6 notch deep, extending approximately 1/2 of disk, lateral carina absent.

Sculpture: Clypeus punctation fine and dense (IS < 1 PD). Paraocular punctation coarse and dense (IS < 1 PD). Supraclypeal area punctation fine and sparse (IS = 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 1 MOD from dorsal tangent of antennal socket. Frons finely reticulate. Vertex punctation fine and dense (IS < 1 PD). Mesoscutum punctation coarse and dense (IS < 1 PD). Scutellum punctation coarse and dense laterally (IS < 1 PD) coarsely reticulate medially. Mesopleuron punctation coarse and dense (IS < 1 PD). Lateral propodeum coarsely reticulate. Posterior propodeum rugose. Posterior propodeum tessellate. Dorsal face of T1 punctation fine and dense (IS < 1 PD). T2 basal impression deep, approximately 1/3 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus yellow. Supraclypeal area with quadrate yellow mark. Lower paraocular area yellow reaching clypeus medially extending along compound eyes laterally terminating in line with ventral tangent of antennal socket. Labral process yellow. Mandible yellow. Scape black. Flagellomeres F2-F11 yellow ventrally. Pronotal lobe black. Tegula brown. Wing veins and stigma brown, membrane light brown. Fore tibia yellow anteriorly dark posteriorly, mid and hind tibia yellow apically and basally. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity long, yellow. Mesopleuron pilosity medium-length, white. Sternite pubescence colour white. S3 pubescence medium-length, dense. S4 pubescence medium-length, dense. S5 pubescence long, medially directed apicolateral fringes.

Female:

Structure: Body length range 5.22–6.58 mm. Head broader than long (HL/HW ratio 0.84). Face below antennae convex. Labral process rectangular, broader than long, apex truncate. Clypeus without median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.08). Posterior ocelli 0.35 mm apart. Flagellomeres slightly broader than long. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.28 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.062 mm.

Sculpture: Clypeus punctation coarse and dense (IS ≤ 1 PD). Paraocular punctation coarse and dense medially (IS < 1 PD) sparser laterally (IS = 1 – 2 PD). Supraclypeal area punctation fine and dense (IS < 1 PD). Fovea clavate. Foveae converging above, narrow end terminating along midline of antennal socket. Frons punctation reticulate. Vertex punctation reticulate. Mesoscutum punctation reticulate anteriorly sparser medially (IS = 1 – 2 PD). Scutellum punctation reticulate, rugose medially. Mesopleuron punctation coarse and sparse (IS 1 – 2 PD) reticulate dorsally. Lateral propodeum punctation reticulate. Posterior propodeum punctation reticulate. Posterior propodeum tessellate. Dorsal face of T1 punctation very minute and sparse (IS > 10 PD). T2 basal impression shallow, approximately 1/2 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation absent.

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F3-F10 yellow ventrally. Pronotal lobe black. Tegula pale yellow. Wing veins and stigma light brown, membrane hyaline. Fore and mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity medium-length, white. Scutellum pilosity long, white. Mesopleuron pilosity medium-length, white. Sternite pubescence colour white. S3 pubescence short, sparse. S4 pubescence short, sparse. S5 pubescence long, medially directed apicolateral fringes.

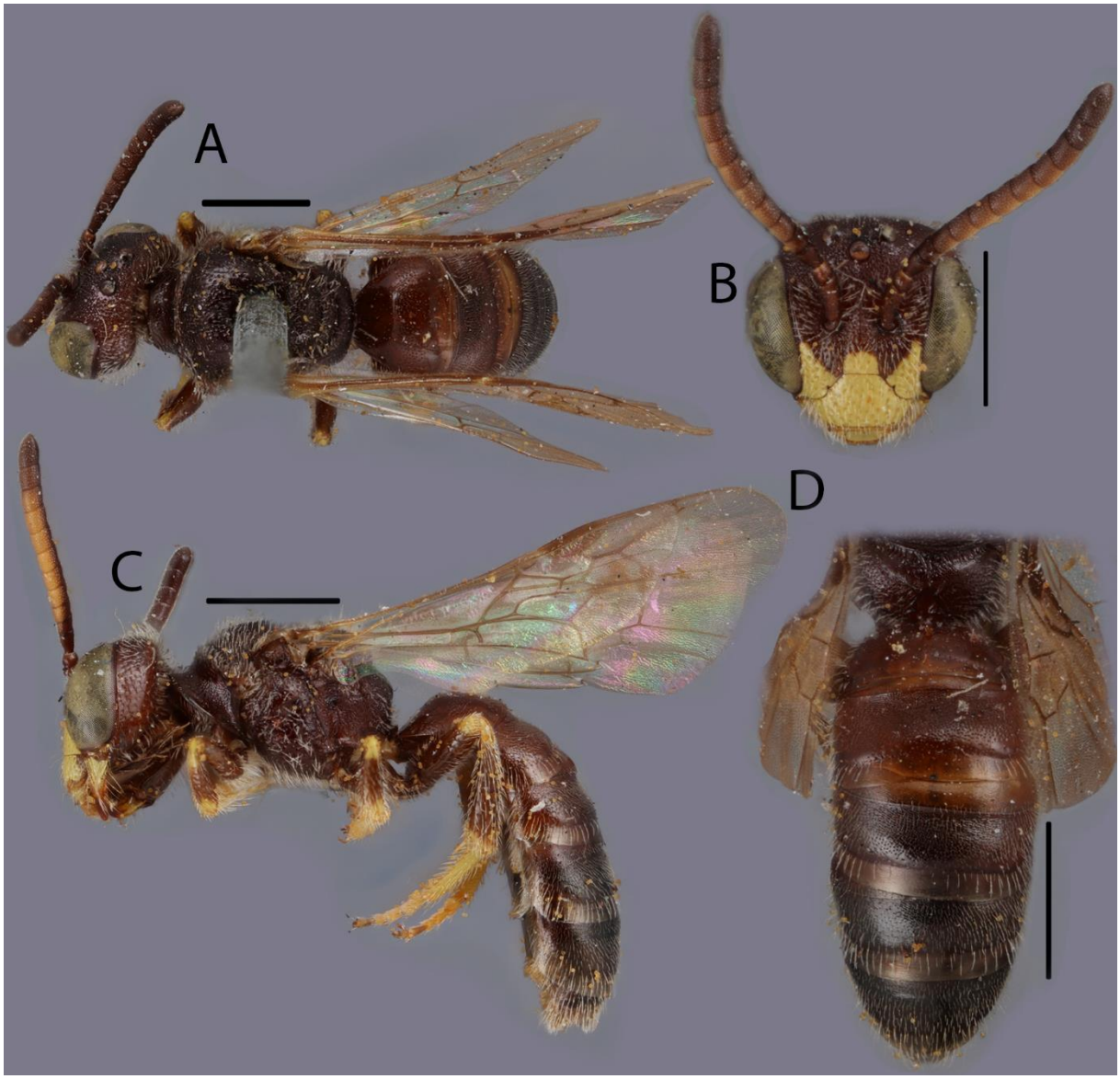


Figure 112. *Protandrena* (*Pterosarus*) *solidaginis*, ♂. INHS_290546. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

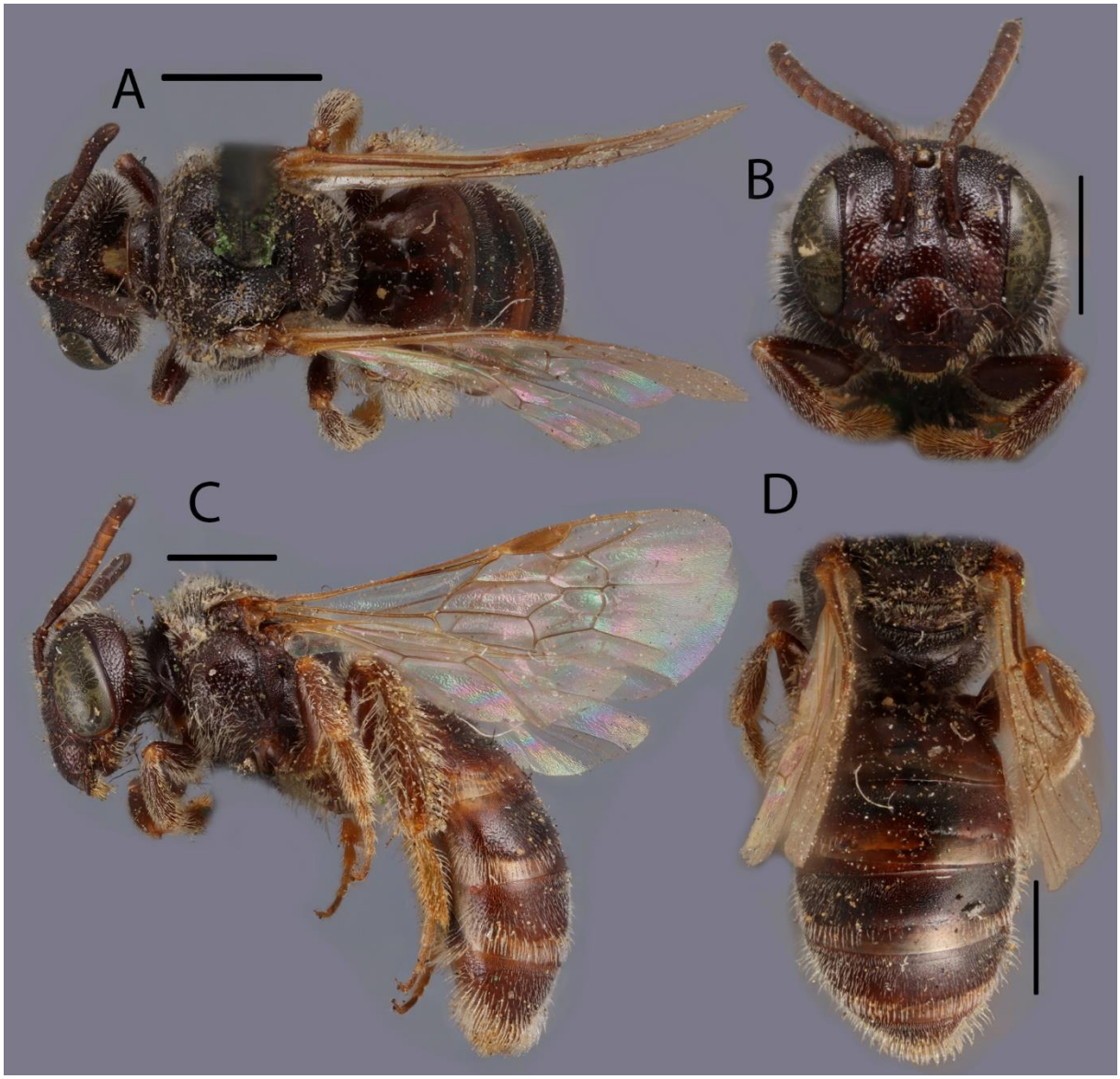


Figure 113. *Protandrena* (*Pterosarus*) *solidaginis*, ♀. INHS_290534. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena solidaginis* is active from mid-August to late October. Kathirithamby and Taylor (2005) recorded the parasite of *Protandrena solidaginis* as *Crawfordia pulvinipes*. Floral records for the species are poor, and no specificity is apparent.

Robertson (1922) notes females collecting pollen from both Astereae and Heliantheae across four different genera.

Range: USA (Illinois, Kansas, Louisiana, Maryland, Mississippi, Missouri, Virginia).

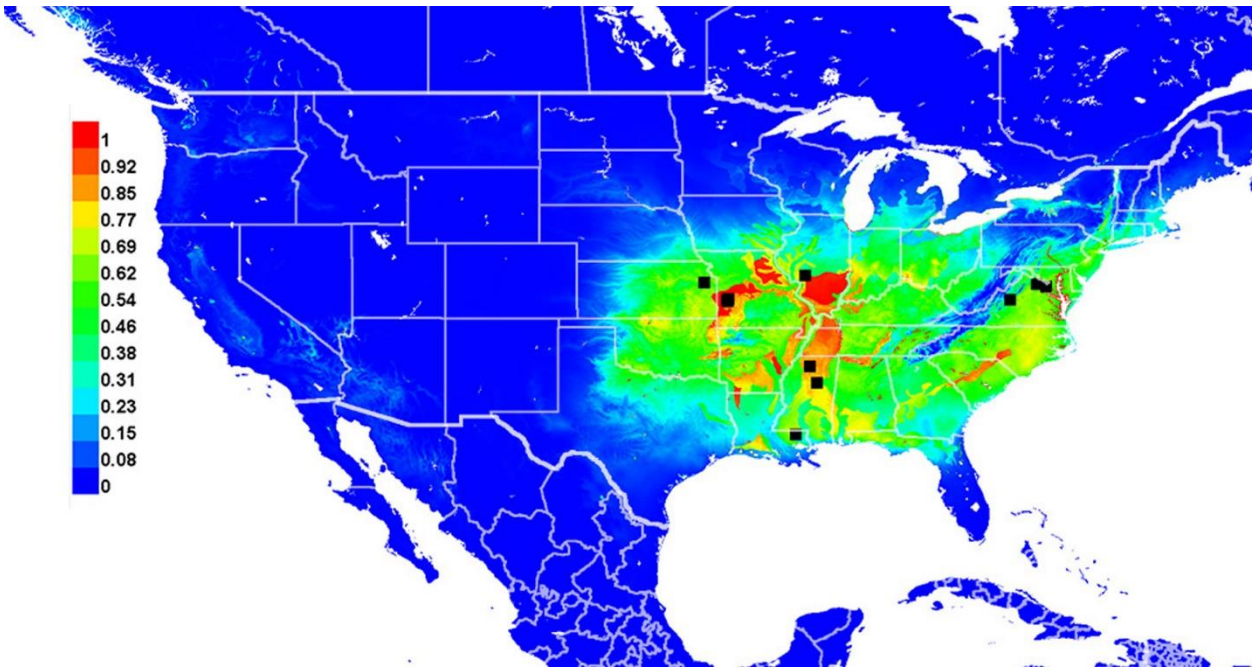


Figure 114. Georeferenced collection records of *Protandrena* (*Pterosarus*) *solidaginis* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *subtilis* new species**

(Figure 115)

Diagnosis:

Females of *Pr*. (*Pt*.) *subtilis* can be recognized by a combination of their finely densely punctate posterior face of propodeum (IS < 1 PD) (contrast all except: *Pr*. *aestivalis, Pr*. *albitarsis, Pr*. *alveus, Pr*. *atricornis, Pr*. *labrosiformis, Pr*. *leucoptera, Pr*. *luxsolaris, Pr*. *nudescens, Pr*.

ornatipes, *Pr. subtilis*, *Pr. vigvierae*), uniformly fine and dense scutum punctures (IS < 1 PD) (contrast *Pr. aestivalis*, *Pr. albitarsis*, *Pr. alveus*, *Pr. atricornis*, *Pr. labrosiformis*, *Pr. leucoptera*, *Pr. nudescens*), and finely punctate marginal zone of terga (contrast remaining).

Material examined:

USA – **Arizona** • 1♀; Cochise, Portal, Southwest Research Station; [31.884° N, 109.2061° W]; elev. 1646 m.; 01 Oct. 1964; Roth V. leg.; AMNH

Description:

Female:

Structure: Body length 5.07 mm. Head broader than long (HL/HW ratio 0.88). Face below antennae convex. Labral process trapezoidal, broader than long, apex rounded. Clypeus without median impressed line. Compound eyes parallel (UOD/LOD ratio 1). Posterior ocelli 0.23 mm apart. Flagellomeres broader than long. Dorsal pronotal carina absent. Prosternum not produced. ITD 1 mm. Metapostnotum weakly extended medially <25% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.05 mm.

Sculpture: Clypeus punctation fine and sparse (IS = 1 PD). Paraocular punctation fine and dense (IS < 1 PD). Supraclypeal area punctation fine and dense (IS < 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 1/2 way down antennal socket. Frons finely reticulate. Vertex finely reticulate. Mesoscutum punctation fine and dense (IS < 1 PD). Scutellum punctation fine and dense (IS < 1 PD). Mesopleuron punctation fine and sparse (IS = 1 PD). Lateral propodeum punctation fine and dense (IS < 1 PD). Posterior propodeum punctation fine and dense (IS < 1 PD). Posterior propodeum tessellate. Dorsal face of T1 punctation fine and

dense (IS < 1 PD). T2 basal impression shallow, approximately 1/3 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F3-F10 yellow ventrally. Pronotal lobe black. Tegula yellow. Wing veins and stigma brown, membrane hyaline. Fore and mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, yellow/brown. Scutellum pilosity medium-length, white. Mesopleuron pilosity long, white. Sternite pubescence colour yellow/brown. S3 pubescence medium-length, sparse. S4 pubescence medium-length, sparse. S5 pubescence medium-length, sparse.

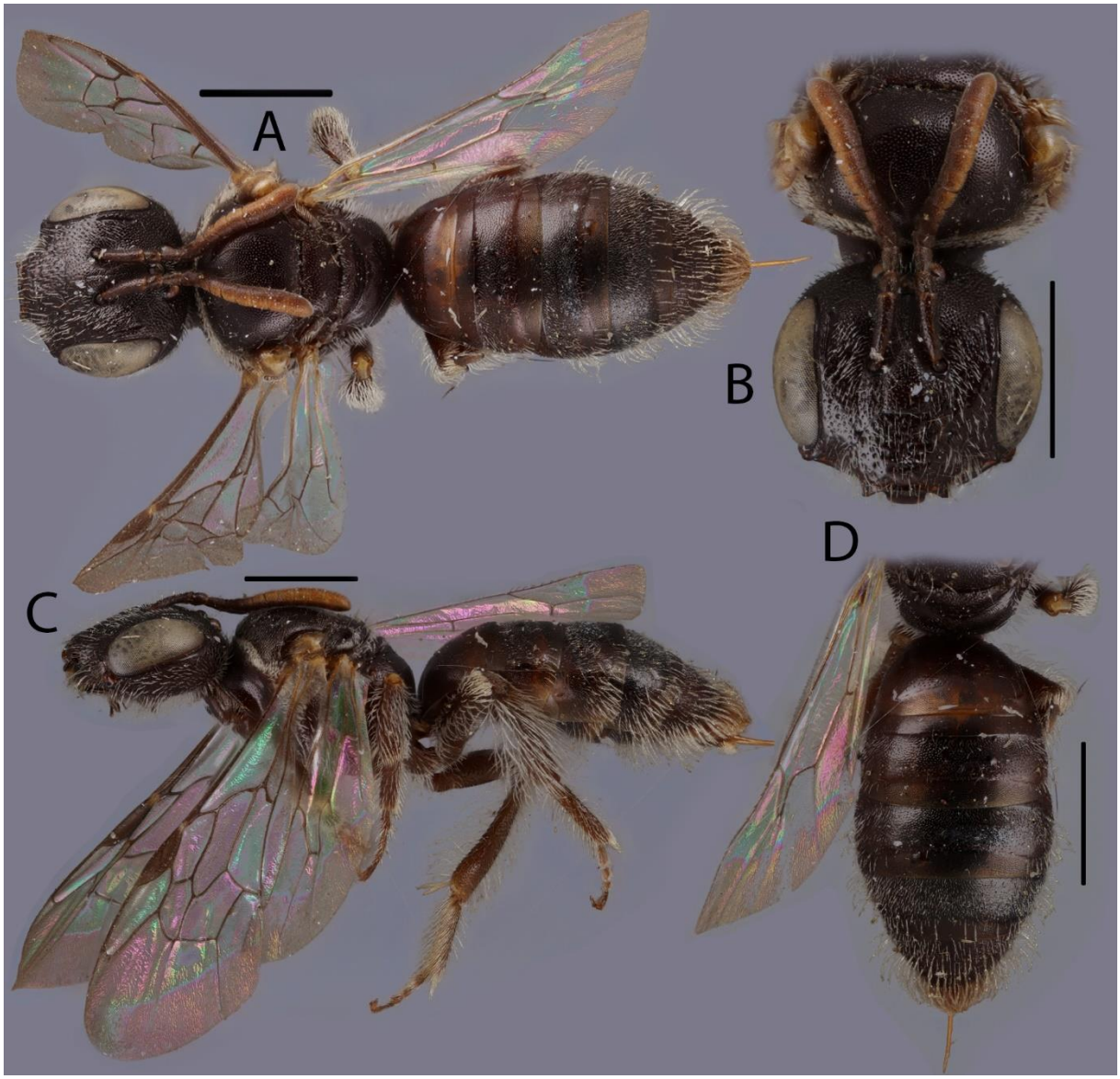


Figure 115. *Protandrena* (*Pterosarus*) *subtilis*, ♀. AMNH_00292002. A. Dorsal habitus. B. Face. C. Lateral habitus. D. Metasoma. Scale bars: 1 mm.

***Protandrena* (*Pterosarus*) *vicina* (Timberlake)**

(Figure 116, Figure 117)

Pseudopanurgus (*Pterosarus*) *vicinus* Timberlake, 1967: 11. ♀♂. Holotype ♀ AMNH: 324618. Type locality: USA; Arizona: Southwest Research Station. 2 Sep 1962. Examined by photos.

Type specimens: Timberlake (1967) described *Pseudopanurgus* (*Pterosarus*) *vicinus* from six male and five female specimens. The holotype specimen by original designation is a female at the AMNH.

Diagnosis:

Males of *Pr*. (*Pt*.) *vicina* can be recognized by a combination of their rugose posterior face of propodeum (contrast all except: *Pr. aestivalis, Pr. albertensis, Pr. albitarsis, Pr. alveus, Pr. andrenoides, Pr. californica, Pr. chepesepe, Pr. citripes, Pr. compositarum, Pr. leucoptera, Pr. piercei, Pr. rudbeckiae, Pr. skeggox, Pr. solidaginis, Pr. vigvierae*), dark pronotal lobes (contrast *Pr. aestivalis, Pr. albertensis, Pr. alveus, Pr. andrenoides, Pr. piercei, Pr. rudbeckiae, Pr. skeggox*), uniformly coarse and dense scutum punctures (IS < 1 PD) (contrast *Pr. albitarsis, Pr. californica, Pr. chepesepe, Pr. citripes, Pr. compositarum, Pr. leucoptera, Pr. vigvierae*) and scutellum uniformly punctate throughout (contrast *Pr. solidaginis*).

Females of *Pr*. (*Pt*.) *vicina* can be recognized by their uniquely deep coarse and dense punctures of scutum (contrast all other species).

Material examined:

USA – **Arizona** • 2♂♂; Cochise, Portal, Southwest Research Station; [31.884° N, 109.2061° W]; elev. 1646 m.; 26 Aug. 1966; Rozen J.G., Rozen B.L. leg.; AMNH • 2♀♀; same location as preceding; 02 Sep. 1962; Statham M. leg.; AMNH • 1♀; same location as preceding; 02 Sep. 1962; Statham M. leg.; AMNH – **Colorado** • 1♂; Boulder, Jamestown (4 mi. W); 40.125° N, 105.4614° W; elev. 2591 m.; 06 Aug. 1962; Lanham U.N. leg.; UCMC • 1♂; Clear Creek, Georgetown; 39.7167° N, 105.6833° W; elev. 2600 m.; 20 Aug. 2001; Irwin M.E., Lamkin C.,

Metz M., Hauser M. leg.; BBSL • 1♂; Huerfano, Cucharas Pass; [37.3326° N, 105.0958° W]; elev. 3030 m.; 09 Aug. 1977; Lanham U.N., Byron P. leg.; UCMC

Description

Male:

Structure: Body length range 4.52–4.9 mm. Head broader than long (HL/HW ratio 0.89). Face below antennae convex. Labral process trapezoidal, broader than long, apex emarginate. Clypeus without median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.33). Posterior ocelli 0.24 mm apart. Flagellomeres longer than broad. Dorsal pronotal carina absent. Prosternum not produced. ITD 0.84 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 0.09 mm. S6 notch shallow, less than 1/3 of disk, lateral carina absent.

Sculpture: Clypeus punctation coarse and dense (IS < 1 PD). Paraocular punctation coarse and dense (IS < 1 PD). Supraclypeal area punctation coarse and dense (IS < 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 0.5 MOD from dorsal tangent of antennal socket. Frons finely reticulate. Vertex punctation fine and dense (IS < 1 PD). Mesoscutum punctation coarse and dense (IS < 1 PD). Scutellum punctation coarse and dense (IS < 1 PD). Mesopleuron punctation coarse and dense (IS < 1 PD). Lateral propodeum coarsely reticulate. Posterior propodeum rugose. Posterior propodeum not microsculptured. Dorsal face of T1 punctation fine and dense (IS < 1 PD). T2 basal impression deep, approximately 3/4 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus yellow. Supraclypeal area with large rectangular yellow mark. Lower paraocular area yellow reaching clypeus medially extending along compound eyes laterally terminating 1.5 MOD from antennal socket in line with supraclypeal mark. Labral process yellow. Mandible yellow. Scape black. Flagellomeres dark. Pronotal lobe black. Tegula brown. Wing veins and stigma brown, membrane light brown. Fore tibia yellow anteriorly dark posteriorly, mid and hind tibia yellow at the apical and basal most portions. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity medium-length, white. Mesopleuron pilosity medium-length, white. Sternite pubescence colour white. S3 pubescence medium-length, sparse. S4 pubescence medium-length, sparse. S5 pubescence medium-length, sparse.

Female:

Structure: Body length range 5.43–5.57 mm. Head broader than long (HL/HW ratio 0.86). Face below antennae convex. Labral process trapezoidal, broader than long, apex truncate. Clypeus without median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.06). Posterior ocelli 0.28 mm apart. Flagellomeres broader than long. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.1 mm. Metapostnotum weakly extended medially <25% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.06 mm.

Sculpture: Clypeus punctation coarse and dense (IS < 1 PD). Paraocular punctation coarse and dense (IS < 1 PD). Supraclypeal area punctation fine and dense (IS < 1 PD). Fovea clavate. Foveae converging above, narrow end terminating in line with dorsal tangent of antennal socket. Frons finely reticulate. Vertex punctation fine and dense (IS < 1 PD). Mesoscutum punctation coarse and dense (IS < 1 PD). Scutellum punctation fine and dense (IS < 1 PD). Mesopleuron

punctation fine and dense (IS < 1 PD). Lateral propodeum finely reticulate. Posterior propodeum finely reticulate. Posterior propodeum not microsculptured. Dorsal face of T1 punctation fine and dense (IS < 1 PD) impunctate medially. T2 basal impression shallow, approximately 1/2 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F4-F8 yellow ventrally. Pronotal lobe black. Tegula brown. Wing veins and stigma brown, membrane light brown. Fore and mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, yellow. Scutellum pilosity long, white. Mesopleuron pilosity medium-length, white. Sternite pubescence colour yellow. S3 pubescence medium-length, sparse. S4 pubescence medium-length, sparse. S5 pubescence medium-length, sparse.

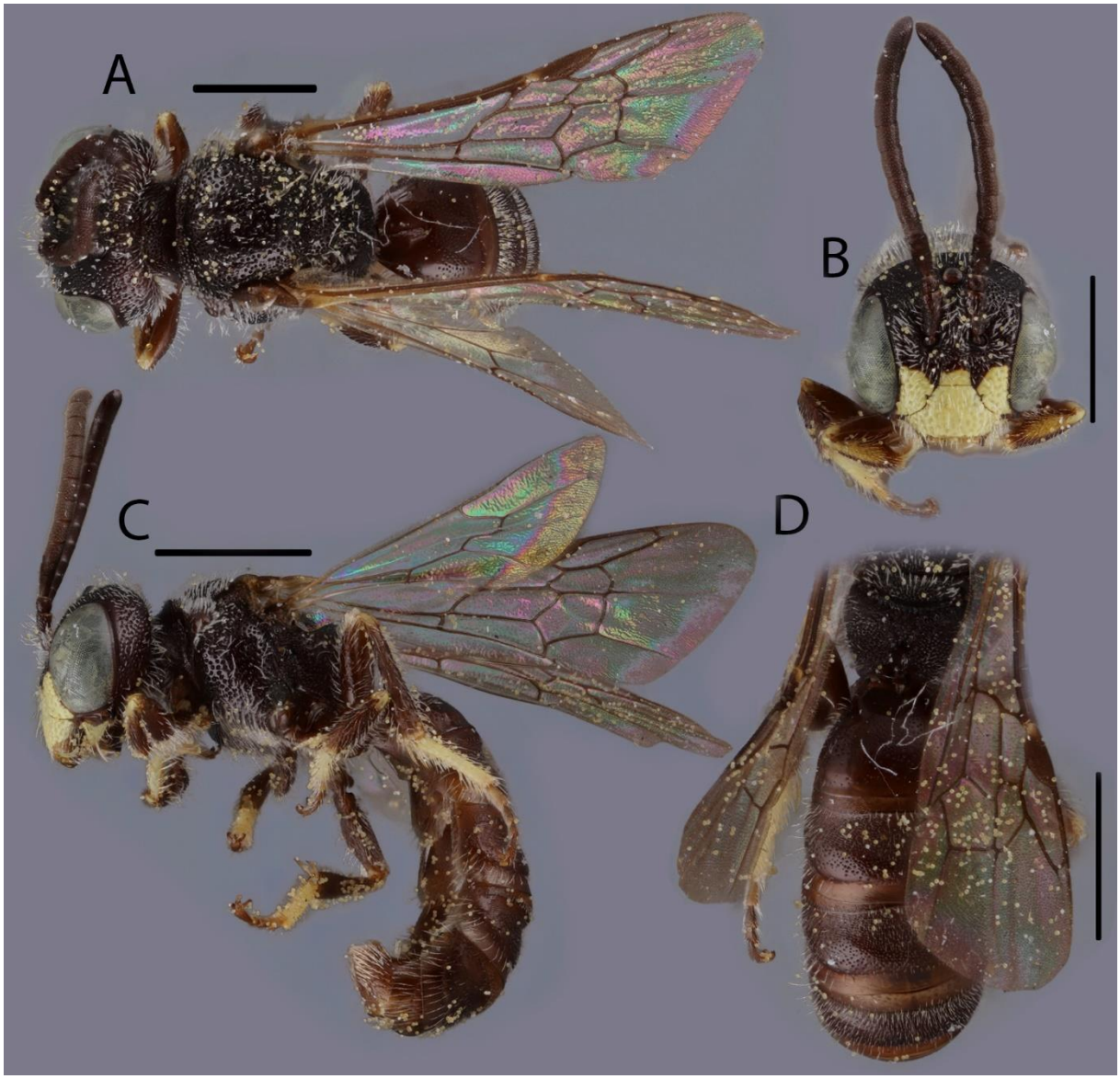


Figure 116. *Protandrena* (*Pterosarus*) *vicina*, ♂. AMNH_00292014. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

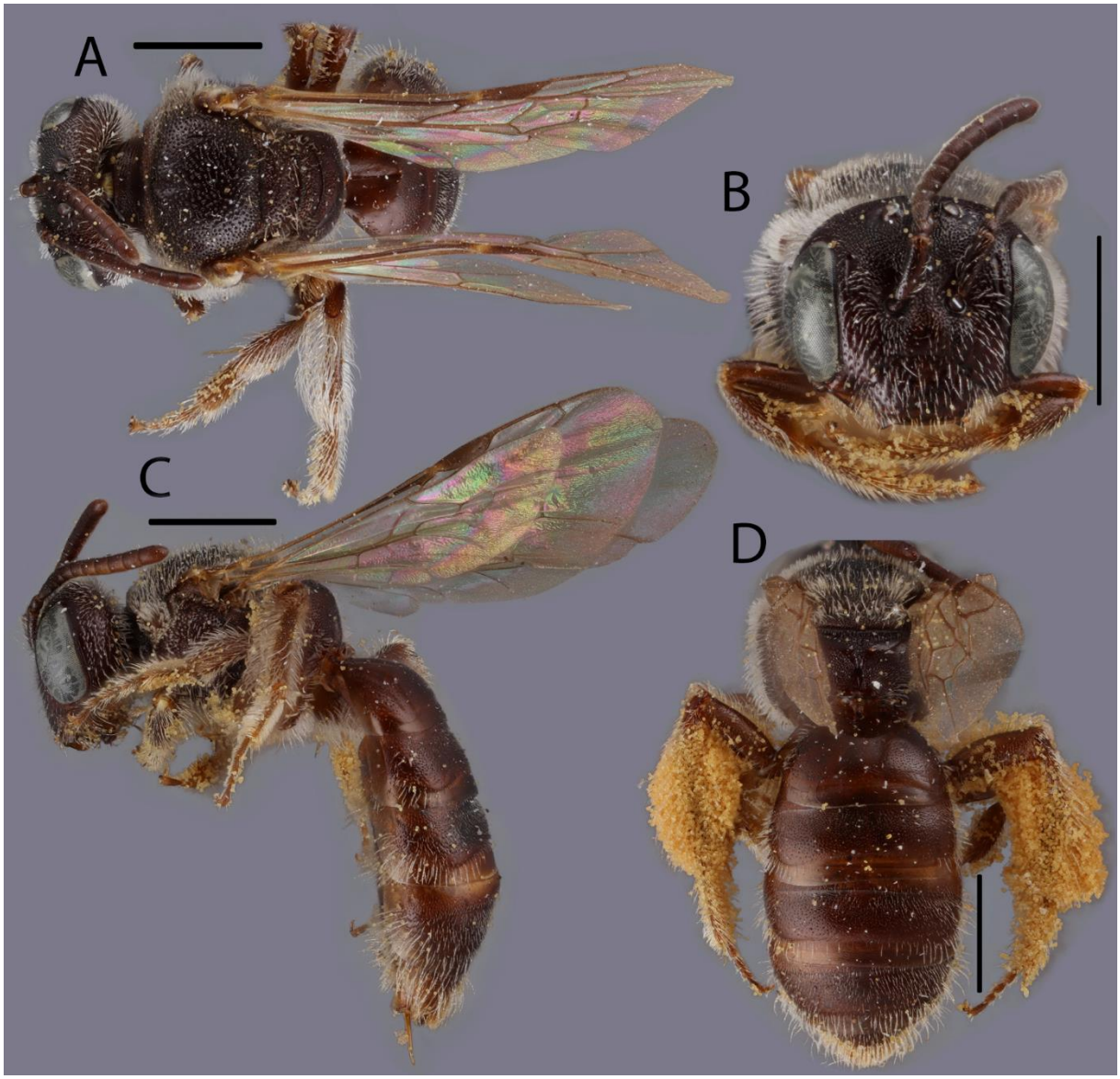


Figure 117. *Protandrena* (*Pterosarus*) *vicina*, ♀. AMNH_00292014, AMNH_00292032. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

Biological notes: *Protandrena vicina* flies from early August to early September. The only floral records for the species are two males collected on *Xanthisma gracile*.

Range: USA (Arizona, Colorado).

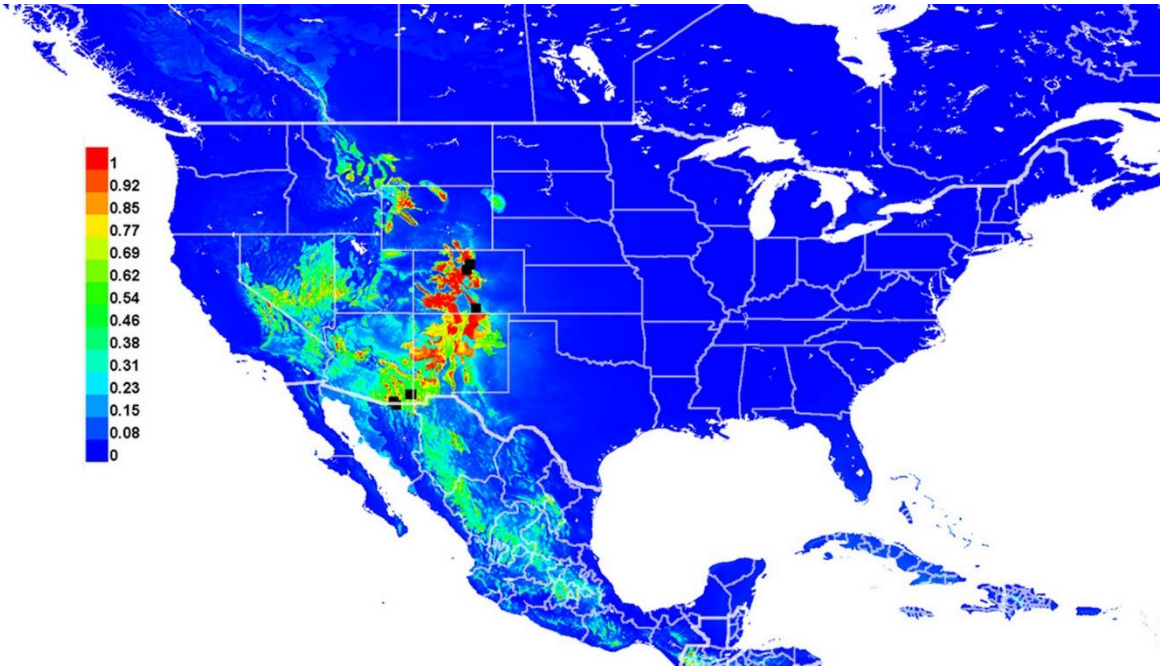


Figure 118. Georeferenced collection records of *Protandrena* (*Pterosarus*) *vicina* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *vigvierae* new species**

(Figure 119, Figure 120)

Holotype: ♂ **USA** – **New Mexico** • Taos, Ojo Caliente (10 mi. E); [36.3096° N, 105.8637° W]; 17 Aug. 1962; Rozen J.G., Rozen B.L. leg.; AMNH. AMNH_IZC 00292029

Diagnosis:

Males of *Pr.* (*Pt.*) *vigvierae* can be recognized by a combination of their rugose posterior face of propodeum (contrast all except: *Pr. aestivalis, Pr. albertensis, Pr. albitarsis, Pr. alveus, Pr. andrenoides, Pr. californica, Pr. chepesepe, Pr. citripes, Pr. compositarum, Pr. leucoptera, Pr. piercei, Pr. rudbeckiae, Pr. skeggox, Pr. solidaginis, Pr. vicina*), uniformly fine and dense

scutum punctures contrast (*Pr. aestivalis, Pr. albertensis, Pr. albitarsis, Pr. alveus, Pr. andrenoides, Pr. californica, Pr. chepesepe, Pr. citripes, Pr. compositarum, Pr. leucoptera, Pr. rudbeckiae, Pr. skeggox, Pr. solidaginis, Pr. vicina*), and dark pronotal lobes (contrast *Pr. piercei*).

Females of *Pr.* (*Pt.*) *vigvierae* can be recognized by a combination of their finely and densely punctured posterior face of propodeum (IS < 1 PD) (contrast all except: *Pr. aestivalis, Pr. albitarsis, Pr. alveus, Pr. atricornis, Pr. labrosiformis, Pr. leucoptera, Pr. luxsolaris, Pr. nudescens, Pr. ornatipes, Pr. subtilis*), uniformly fine and dense scutum punctures (IS < 1 PD) (contrast *Pr. aestivalis, Pr. albitarsis, Pr. alveus, Pr. atricornis, Pr. labrosiformis, Pr. leucoptera, Pr. luxsolaris, Pr. nudescens*), and coarsely densely punctate mesopleuron (contrast remaining).

Material examined:

USA – **New Mexico** • 1♀, 1♂♂; Taos, Ojo Caliente (10 mi. E); [36.3096° N, 105.8637° W]; 17 Aug. 1962; Rozen J.G., Rozen B.L. leg.; AMNH

Description:

Male:

Structure: Body length 5 mm. Head broader than long (HL/HW ratio 0.85). Face below antennae convex. Labral process trapezoidal, broader than long, apex emarginate. Clypeus without median impressed line. Compound eyes strongly convergent below (UOD/LOD ratio 1.24). Posterior ocelli 0.25 mm apart. Flagellomeres longer than broad. Dorsal pronotal carina absent. Prosternum not produced. ITD 0.8 mm. Metapostnotum strongly extended medially >50% way

to propodeal pit. Tarsi 2–4 triangular. Fore tarsi width 1 mm. S6 notch shallow, less than 1/3 of disk, lateral carina absent.

Sculpture: Clypeus punctation coarse and dense (IS < 1 PD). Paraocular punctation coarse and dense (IS < 1 PD). Supraclypeal area punctation fine and dense (IS < 1 PD). Fovea clavate. Foveae converging above, narrow end terminating 0.5 MOD from dorsal tangent of antennal socket. Frons finely reticulate. Vertex finely reticulate. Mesoscutum punctation fine and dense (IS < 1 PD). Scutellum punctation coarse and dense (IS < 1 PD). Mesopleuron punctation fine and dense (IS < 1 PD). Lateral propodeum finely reticulate. Posterior propodeum rugose. Posterior propodeum tessellate. Dorsal face of T1 punctation fine and dense (IS < 1 PD). T2 basal impression deep, approximately 1/2 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus yellow. Supraclypeal area yellow to within 0.5 MOD of antennal socket. Lower paraocular area yellow reaching ventral tangent of antennal socket medially, extending along margin of compound eye terminating in line with dorsal tangent of antennal socket. Labral process yellow. Mandible yellow. Scape black. Flagellomeres dark. Pronotal lobe black. Tegula yellow. Wing veins and stigma light brown, membrane light brown. Fore and mid tibia yellow anteriorly dark posteriorly, hind tibia mostly yellow with dark spot on distal portion of tibia taking up approximately 1/4. Tarsi yellow.

Pubescence: Mesoscutum pilosity short, yellow/brown. Scutellum pilosity medium-length, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium-length, dense. S4 pubescence medium-length, dense. S5 pubescence medium-length, medially directed apicolateral fringes.

Female:

Structure: Body length 5.67 mm. Head broader than long (HL/HW ratio 0.82). Face below antennae convex. Labral process trapezoidal, broader than long, apex truncate. Clypeus without median impressed line. Compound eyes parallel (UOD/LOD ratio 1). Posterior ocelli 0.28 mm apart. Flagellomeres broader than long. Dorsal pronotal carina absent. Prosternum not produced. ITD 1.12 mm. Metapostnotum strongly extended medially >50% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.0625 mm.

Sculpture: Clypeus punctation fine and sparse (IS = 1 PD). Paraocular punctation fine and sparse (IS > 1 PD). Supraclypeal area punctation fine and sparse (IS > 1 PD). Fovea clavate. Foveae converging above, narrow end terminating in line with dorsal tangent of antennal socket. Frons finely reticulate. Vertex finely reticulate. Mesoscutum punctation fine and dense (IS < 1 PD). Scutellum punctation fine and dense (IS < 1 PD). Mesopleuron punctation coarse and dense (IS < 1 PD). Lateral propodeum finely reticulate. Posterior propodeum punctation fine and dense (IS < 1 PD). Posterior propodeum tessellate. Dorsal face of T1 punctation fine and dense (IS < 1 PD) impunctate medially and apically. T2 basal impression shallow, approximately 1/2 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation absent.

Colour: Clypeus black. Supraclypeal area yellow along border with clypeus. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres F3-F10 yellow ventrally. Pronotal lobe black. Tegula yellow. Wing veins and stigma pale, membrane hyaline. Fore and mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity long, yellow/brown. Scutellum pilosity long, white. Mesopleuron pilosity long, white. Sternite pubescence colour white. S3 pubescence medium-length, sparse. S4 pubescence medium-length, sparse. S5 pubescence medium-length, sparse.

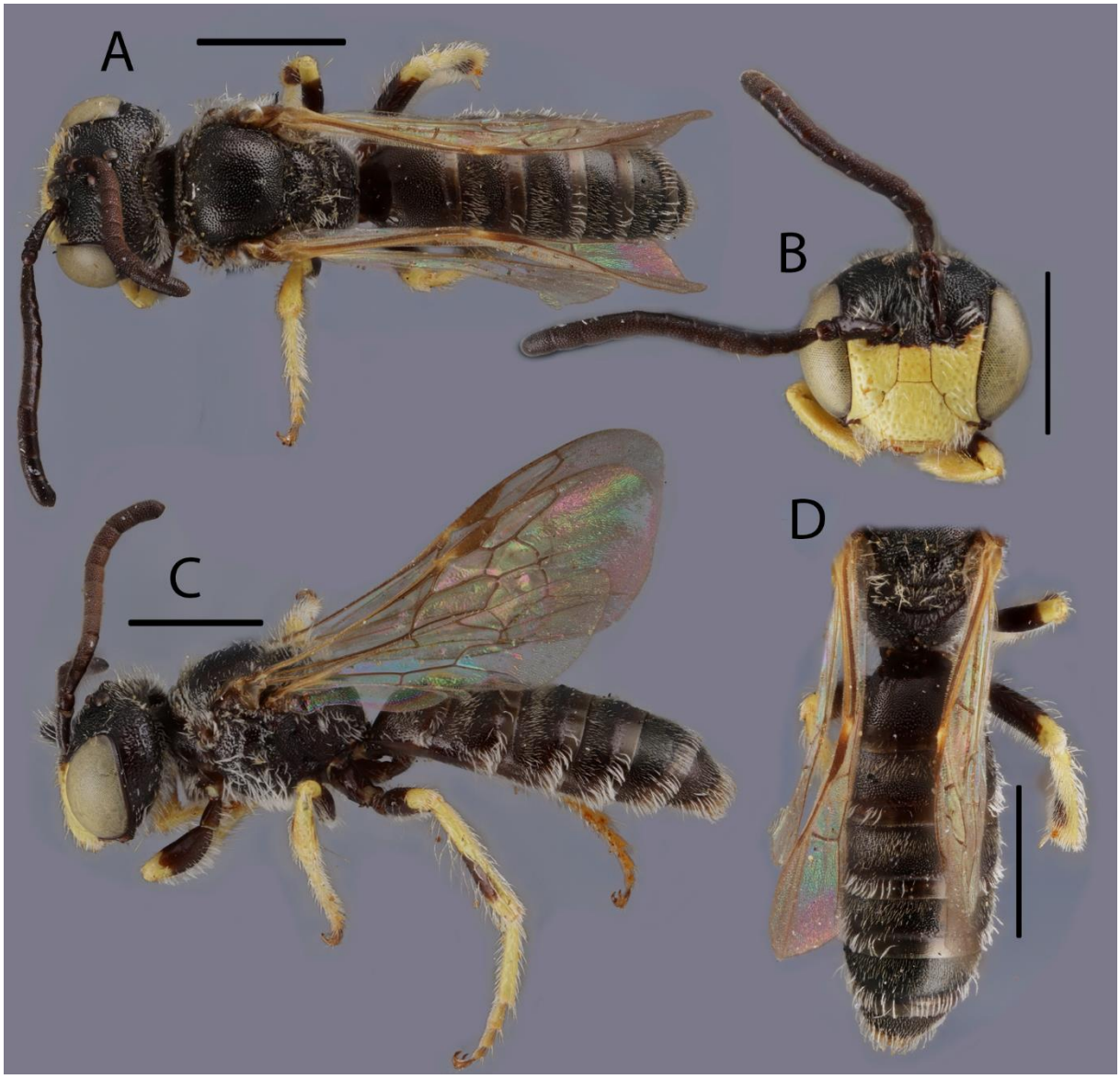


Figure 119. *Protandrena* (*Pterosarus*) *vigvierae*, ♂. AMNH_00292029. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

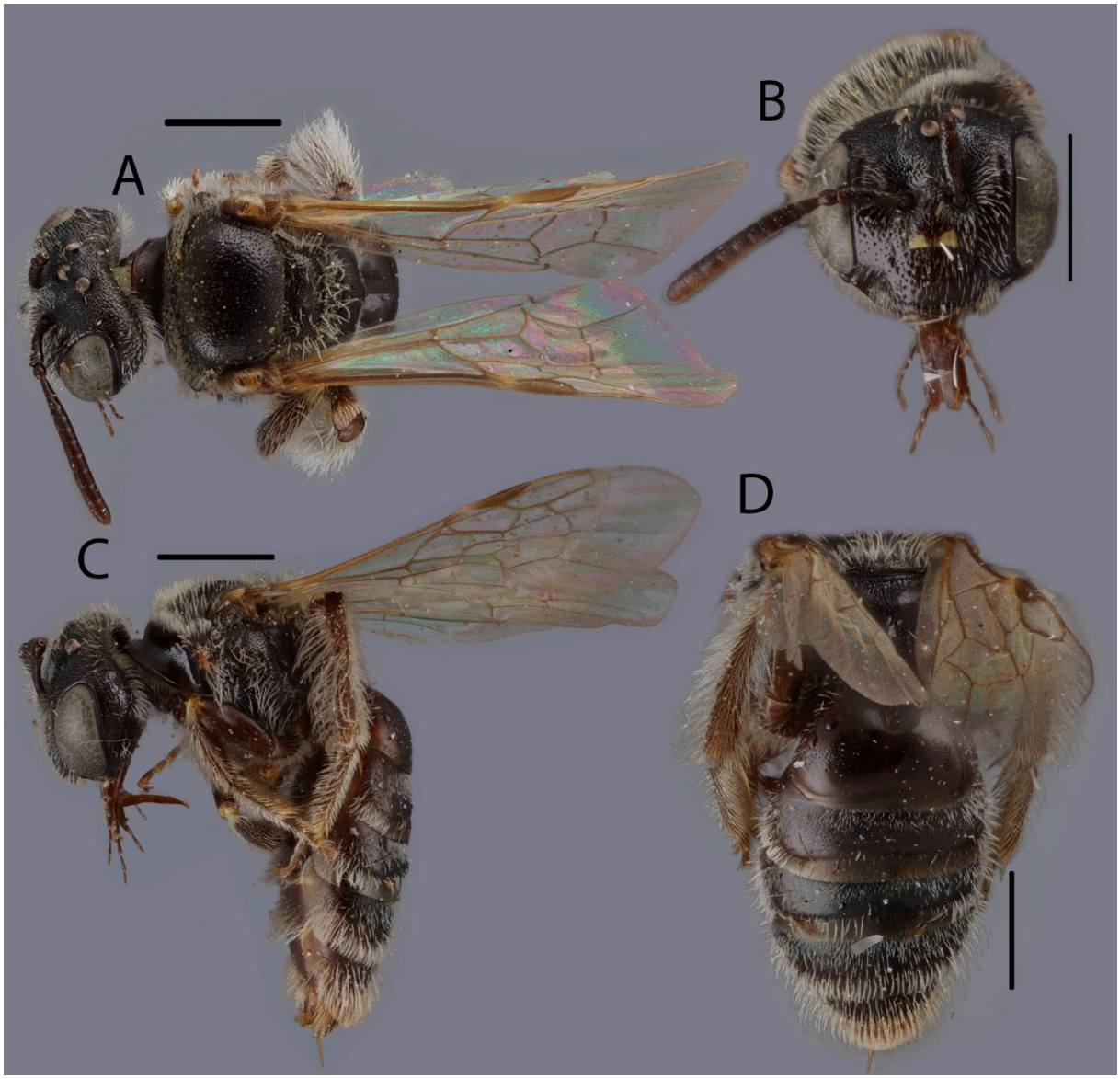


Figure 120. *Protandrena* (*Pterosarus*) *vigvierae*, ♀. AMNH_00292074 **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

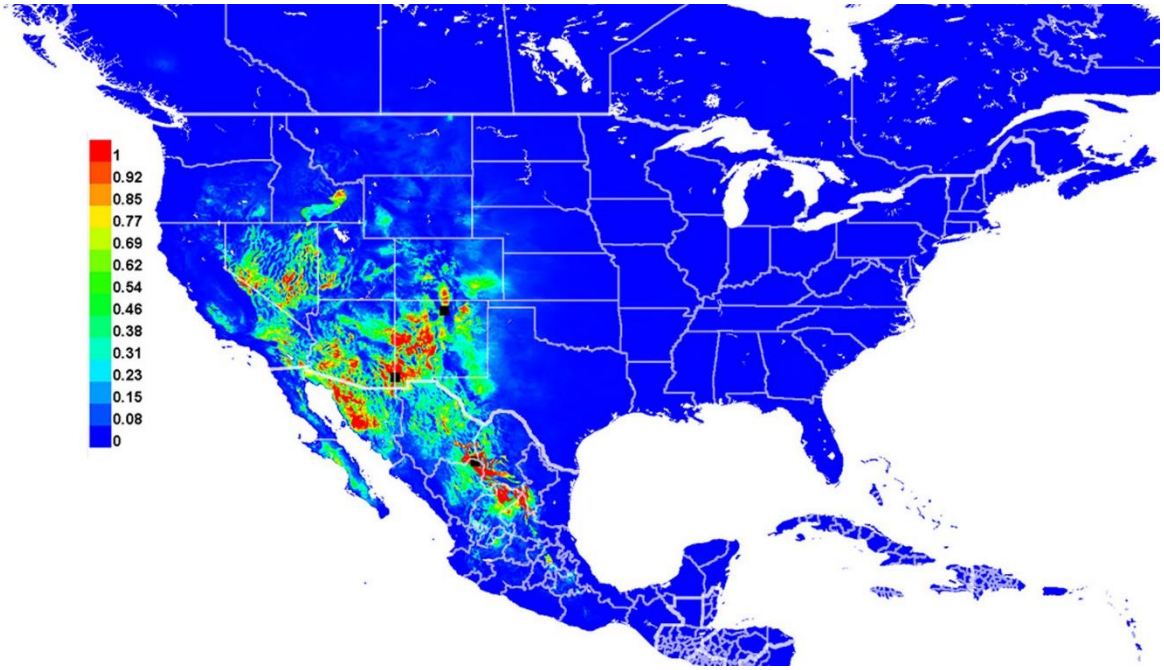


Figure 121. Georeferenced collection records of *Protandrena* (*Pterosarus*) *vigvierae* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

***Protandrena* (*Pterosarus*) *ximenesiae* (Cockerell)**

(Figure 122)

Panurginus ximenesiae Cockerell, 1913: 195. ♀. Holotype ♀ NMNH: 533815. Type locality: USA; New Mexico: Mesilla Park. 12 Sep 1913. ex. *Verbesina encelioides exauriculata*. Examined by photos.

Pseudopanurgus (*Pterosarus*) *stathamae* Timberlake, 1967: 16. ♀. Holotype ♀ AMNH: 324615. Type locality: USA; Arizona: Southwestern Research Station. 2 Sep 1962. Examined by photos.

Type specimens:

Cockerell (1913) described *Panurginus ximenesiae* solely from the female holotype. Timberlake (1967) described *Pseudopanurgus* (*Pterosarus*) *stathamae* solely from the female holotype. Examination of the two types reveals that they share uncommon traits in having yellow pronotal lobes, very sparse scutum punctures, and a densely pubescent pronotal collar.

Diagnosis:

Females of *Pr*. (*Pt*.) *ximenesiae* can be recognized by their yellow pronotal lobes (contrast all except: *Pr*. *albipes, Pr*. *alveus, Pr*. *amor, Pr*. *barberi, Pr*. *labrosa, Pr*. *occidua, Pr*. *ornatipes, Pr*. *quadrapylae*), and sparse scutum punctures (IS > 4 PD) (contrast remaining).

Material examined:

MEXICO – **Durango** • 1♀; Tlahualilo, Mapimí Biosphere Reserve; [26.6051° N, 103.871° W]; 02 Nov. 1980; Rozen J.G., Rozen B.L. leg.; AMNH

USA – **Arizona** • 1♀; Cochise, Portal, Southwest Research Station; [31.884° N, 109.2061° W]; 02 Sep. 1962; Statham M. leg.; AMNH– **New Mexico** • 1♀; Dona Ana, Mesilla Park; [32.2759° N, 106.7667° W]; 12 Sep. 1913; Cockerell T.D.A. leg.; ex *Verbesina encelioides*; USNM

Description

Female:

Structure: Body length range 6.55 mm. Head broader than long (HL/HW ratio 0.82). Face below antennae convex. Labral process U shaped, longer than broad, apex rounded. Clypeus without median impressed line. Compound eyes weakly convergent below (UOD/LOD ratio 1.02). Posterior ocelli. Flagellomeres broader than long. Dorsal pronotal carina absent. Prosternum not

produced. ITD 1.36 mm. Metapostnotum extended medially 25%–50% way to propodeal pit. Tarsi 2–4 conical. Fore tarsi width 0.075 mm.

Sculpture: Clypeus punctation fine and sparse (IS = 2 PD). Paraocular punctation fine and sparse (IS = 1 PD). Supraclypeal area punctation fine and sparse (IS = 1 PD). Fovea clavate. Foveae converging above, narrow end terminating in line with dorsal tangent of antennal socket. Frons punctation fine and dense (IS < 1 PD). Vertex punctation coarse and dense (IS < 1 PD). Mesoscutum punctation fine and sparse (IS > 4 PD). Scutellum punctation fine and sparse laterally (IS > 1 PD) denser medially (IS < 1 PD). Mesopleuron punctation coarse and sparse (IS = 1 PD). Lateral propodeum finely reticulate. Posterior propodeum finely reticulate. Posterior propodeum not microsculptured. Dorsal face of T1 punctation fine and dense (IS < 1 PD). T2 basal impression shallow, approximately 1/2 of T2 lineolate basally. T3 punctation dense (IS < 1 PD). T4 punctation dense (IS < 1 PD).

Colour: Clypeus black. Supraclypeal area black. Lower paraocular area black. Labral process black. Mandible black. Scape black. Flagellomeres dark. Pronotal lobe yellow. Tegula yellow. Wing veins and stigma light brown, membrane light brown. Fore and mid tibia with yellow spot at knee, hind tibia entirely dark. Tarsi dark brown.

Pubescence: Mesoscutum pilosity short, white. Scutellum pilosity medium-length, white. Mesopleuron pilosity medium-length, white. Sternite pubescence colour white. S3 pubescence medium-length, sparse. S4 pubescence medium-length, sparse. S5 pubescence medium-length, sparse.

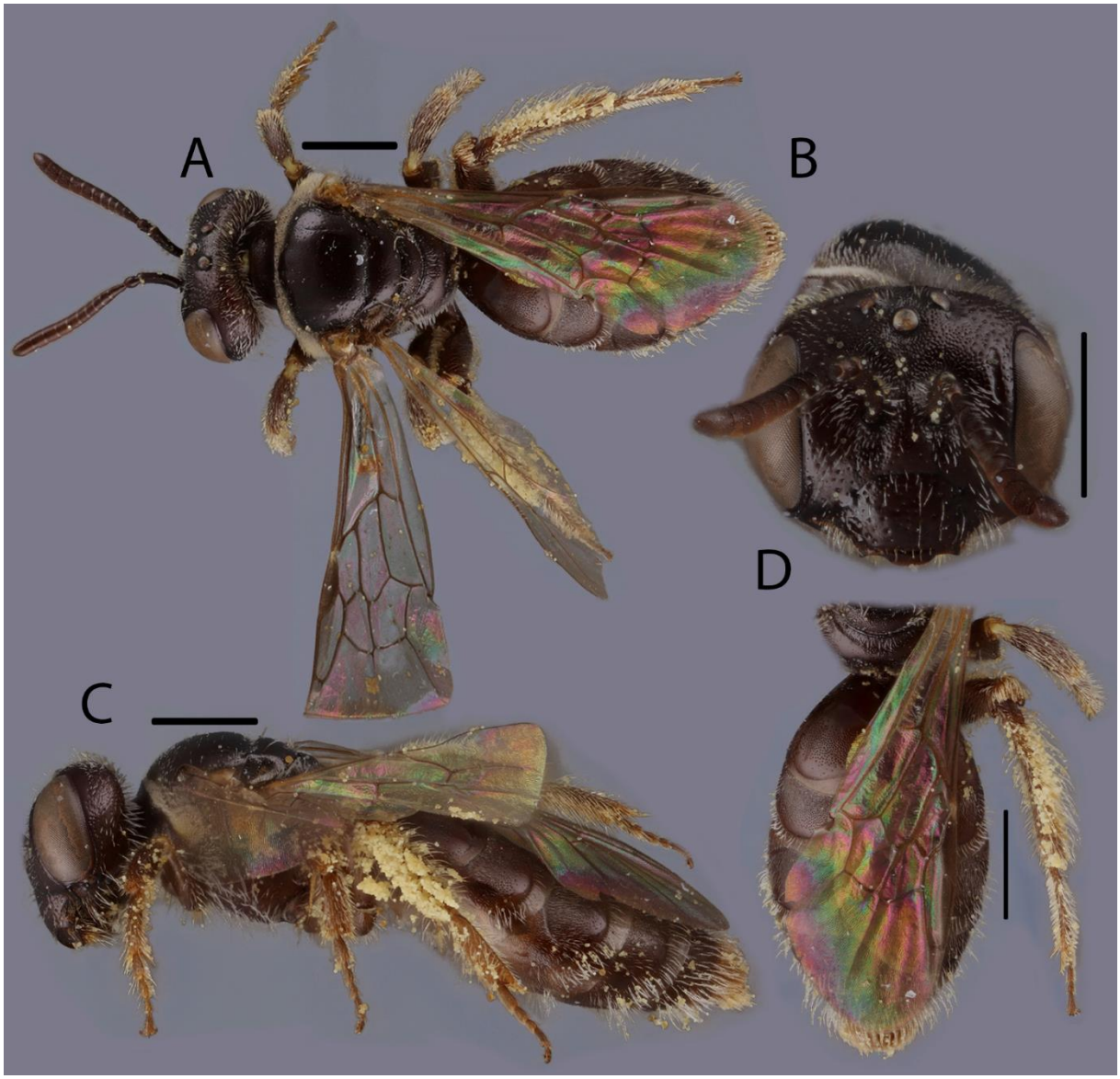


Figure 122. *Protandrena* (*Pterosarus*) *ximenesiae*, ♀. AMNH_00292070. **A.** Dorsal habitus. **B.** Face. **C.** Lateral habitus. **D.** Metasoma. Scale bars: 1 mm.

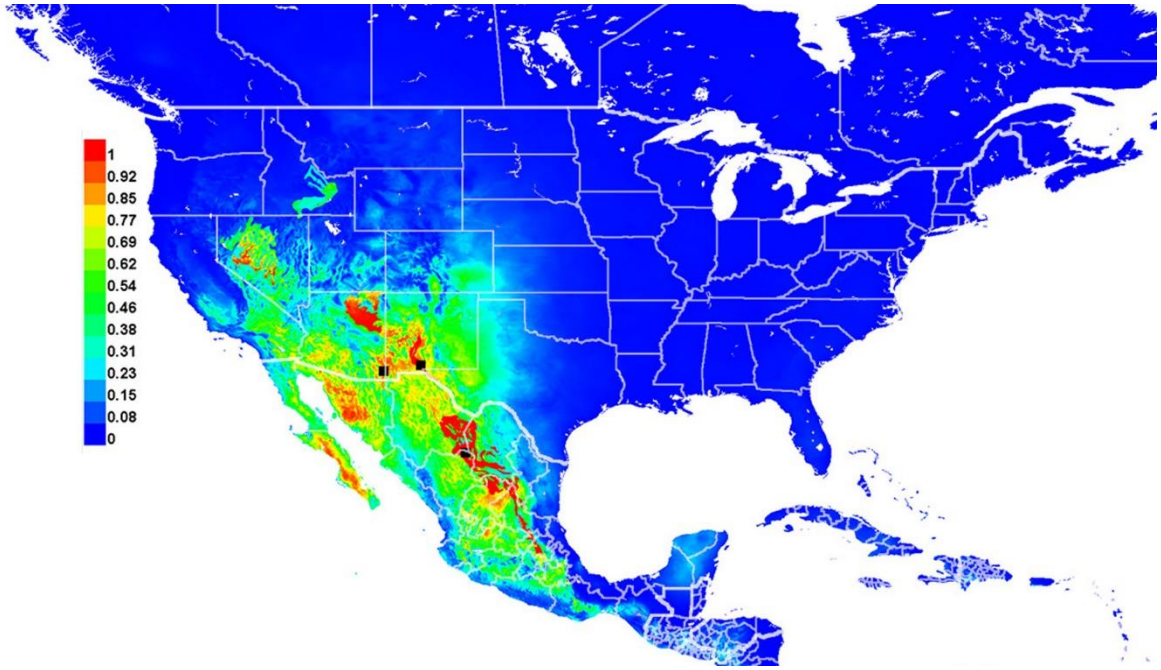


Figure 123. Georeferenced collection records of *Protandrena* (*Pterosarus*) *ximenesiae* (black squares) and predicted distribution using Maxent (colour shading). Warmer colours indicate higher probability of occurrence.

KEYS

Males:

1. Face entirely yellow below antennae (i.e. includes subantennal plate and most of supraclypeal area)… 2

- Face with yellow restricted to lateral marks and clypeus (subantennal plate dark and supraclypeal area with at most a small yellow spot) … 29

2. Scutum punctures sparser medially (IS > 1 PD)… 3

- Scutum punctures uniformly dense throughout. (IS ≤ 1 PD)… 12

3. Posterior face of propodeum macrosculptured throughout… 4

- Posterior face of propodeum with non-macrosculptured space (may be tessellate or imbricate in non-macrosculptured space)…6

4. Clypeus densely punctate (IS < 1 PD) and lacking median impressed line… 5

- Clypeus sparsely punctate (IS > 3 PD) and possesses median impressed line… *chepesepi*

5. S6 notch with sides sinuate, wider subapically than at midlength. Tarsi not compressed and only slightly broader than long… *luxsolaris*

- S6 notch with sides narrowing continuously to apex. Tarsi strongly vertically compressed and notably broader than long… *prata*

6 (3). Scape dark, flagella yellow… 7

- Scape and flagella concolorous… 8

7. Face flattened below antennae. Clypeus with broad median impunctate line. Wing veins and membrane dark. Non-macrosculptured area of posterior face of propodeum dulled by tessellation… *boylei*

- Face not flattened below antennae. Clypeus without median impunctate area. Wing veins and membrane milky white. Non-macrosculptured area of posterior face of propodeum shining… *leucopterus*

8. Scape and flagella yellow… 8

- Scape and flagella dark… 9

9. Dorsal face of T1 densely punctate throughout (IS < 1 PD). Hind tibiae mostly yellow. Fore Tarsi 2–4 triangular with no empty space between the distal points… *irregularis*

- Dorsal face of T1 with sparse punctures (IS > 1 PD) apex with large impunctate space. Hind tibiae mostly dark. Fore Tarsi 2–4 inflated with empty space between the distal points… *rowellae*

10 (8). Face below antennae convex. Punctures of mesopleuron dense (IS < 1 PD)… 11

- Face below antennae flattened. Punctures of mesopleuron sparser (IS > 1 PD)… *planafacialis*

11. Clypeus with impressed median line. Labral process strongly emarginate. T1 densely and finely punctate throughout (IS < 1 PD)… *occultata*

- Clypeus lacking median impressed line. Labral process weakly emarginate. T1 with apical impunctate space… *didirupa*

12 (2). Scutum punctures extremely dense, confluent or very nearly so across entire disk… 13

- Scutum punctures with distinct interspaces, at least on middle of disk… 14

13. Scutum punctures barely separate, subrugose to the point that it dulls the surface of the scutum. Hind tibiae mostly yellow with reduced dark spot medially … *compositarum*

- Scutum punctures more separated, interspaces shining IS < 0.5 PD. Hind tibiae mostly dark, except small basal yellow area … *citripes*

14 (12). Clypeus with sparse and fine punctures (IS > 1 PD)… 15

- Clypeus with dense and coarse punctures (IS ≤ 1 PD)… 19

15. Clypeus punctures denser (maximum IS 1–2 PD)… 16

- Clypeus punctures sparser (IS 1–3 PD)… 17

16. Scutum punctures denser (IS < 1 PD). Dorsal impunctate space of propodeum narrow. Mesopleuron with dense punctures (IS < 1 PD)… *alveus*

Scutum punctures sparser (IS = 1 PD). Dorsal impunctate space of propodeum broad. Mesopleuron punctures sparse (IS > 2 PD)… *quadrapylae*

17 (15). Fore Tarsi 2–4 inflated, apex concave. Yellow maculation of face extends past antennal socket. Dorsal impunctate space of propodeum dulled by microsculpture… 16

- Fore Tarsi 2–4 triangular, apex straight. Yellow maculation of face terminating in straight line below antennal socket. Dorsal impunctate space of propodeum shining, not dulled by microsculpture… *ornatipes*

18. Maculation of face extending past antennal socket in narrow triangular shape along margin of compound eye. Face strongly flattened below antennal socket. Clypeus with median impressed line. Apex of T1 with broad impunctate space. Fore Tarsi 2–4 inflated equally… *boylei*

- Maculation of face extending past antennal socket in broad rectangular shape along margin of compound eye. Face convex below antennal socket. Clypeus without median impressed line. T1 finely densely punctate throughout (IS < 1 PD). Tarsi 2–4 inflated, but extending more to one side than the other… *skeggox*

19 (14). Dorsal face of T1 with a noticeable impunctate line medially… 20

- Dorsal face of T1 finely and densely punctured throughout … 21

20. Hind tarsi mostly dark. Posterior face of propodeum entirely dulled by sculpturing. … *nudescens*

- Hind tarsi mostly yellow. Posterior face of propodeum with dorsal impunctate space. … *occidua*

21 (19). Face below antennal socket notably flattened… 22

- Face below antennal socket convex… 24

22. Fore Tarsi 2–4 triangular with no empty space between the distal points. Facial maculation extends past ventral tangent of antennal socket. Smaller 5–6 mm… 23

- Fore Tarsi 2–4 inflated with empty space between the distal points. Facial maculation does not extend past ventral tangent of antennal socket. Larger 7–9 mm… *piercei*

23. Flagellomeres yellow. Scutum punctures coarse and notably denser along parapsidal lines (IS < 1 PD). T2 basal impression deep, ½ of disk with a steep transition to the densely punctured raised apex … *renimaculata*

- Flagellomeres dark. Scutum punctures fine and entirely uniform throughout, not notably more crowded at any point. T2 basal impression shallow with subtle transition to raised heavily pubescent punctured apex… *aurifodinae*

24 (21). Posterior face of propodeum macrosculptured throughout… 25

- Posterior face of propodeum with non-macrosculptured area… 27

25. Scape and pronotal lobes yellow. Clypeus with median impressed line… 26

- Scape and pronotal lobes dark. Clypeus without median impressed line… *vigvierae*

26. Fore Tarsi 2–4 inflated with empty space between the distal points. Anterior of mesopleuron coarsely reticulate… *albertensis*

- Fore Tarsi 2–4 triangular with no empty space between the distal points. Anterior of mesopleuron coarsely and densely punctate but not reticulate… *aestivalis*

27 (24). Facial maculations yellow, terminate above ventral tangent of antennal socket. Wing membrane and venation dark… 28

- Facial maculation pale white, terminates below ventral tangent of antennal socket. Wing venation pale white, membrane milky… *leucoptera*

28. Facial maculations extend in broad rectangles past ventral tangent of antennal socket along margin of compound eye. Pronotal lobes yellow. T1 finely reticulate…*bilobata*

- Facial maculations extend in narrow triangles past ventral tangent of antennal socket along margin of compound eye. Pronotal lobes dark. T1 finely and densely punctate but not reticulate… *albipes*

29 (1). Posterior face of propodeum smooth, lacking macrosculpture… 30

- Posterior face of propodeum with noticeable sculpturing… 35

30. T1 with denser punctures (IS < 3 PD), at least laterally… 31

- T1 very sparsely punctured (IS > 3 PD)… 33

31. Scutum punctures denser (IS = 1 PD)… 32

- Scutum punctures sparser (IS ≥ 2 PD)… *illustris*

32. Pronotal lobes, legs, and Labral process yellow. Labral process broad, only very slightly narrowed… *amara*

- Pronotal lobes, legs and Labral process dark. Labral process long, and strongly narrowed… *bidentis*

33 (30). T2 basal impression lineolate. Labrum and labral process yellow. Labral process not strongly emarginate… 34

- T2 basal impression polished and impunctate at the anterior margin. Labrum dark, labral process yellow. Labral process strongly emarginate… *barberi*

34. Clypeus punctures coarse and dense (IS < 1 PD). Wing venation pale. Large ~ 7–8 mm… *perlaevis*

- Clypeus punctures fine and sparse (IS = 1 PD). Wing venation dark. Small ~5–6 mm… *labrosa*

35 (29) Labral process and mandibles concolorous, either both dark or both yellow… 36

- . Labral process yellow, mandibles dark, at most yellow on basal third of outer ridge … *atricornis*

36. Labral process and mandibles completely dark … 37

- Labral process and mandibles yellow … 38

37. Lower paraocular area yellow. Mesepisternum coarsely punctate (foveolate). S6 notch with distinct lateral carina. Gonostylus not reflexed. … *albitarsis*

- Lower paraocular area dark. Mesepisternum mixed foveolate-puncticulate. S6 notch without lateral carina. Gonostylus apically reflexed.… *californica*

38 (36). Pronotal lobes yellow. Scutum punctures dense and shallow. 1–1.5 puncture diameters apart max … 39

- Pronotal lobes dark. Scutum punctures deep, coarse and well spaced. 2–3 puncture diameters apart on posterior of disk … 43

39. Face noticeably flattened below antennal socket… 40

- Face convex below antennal socket… 42

40. Scutum punctures fine and dense anteriorly but not reticulate. Fore Tarsi 2–4 inflated with empty space between the distal points. Large 7–9 mm… *piercei* (dark)

- Scutum punctures reticulate anteriorly. Fore Tarsi 2–4 triangular with no empty space between the distal points. Smaller 5–6.5 mm… 41

41. Scutum punctures sparser posteriorly (IS = 1–2 PD). Metapostnotum weakly extended medially, T1 with denser punctures laterally (IS = 1 PD). T2 punctures denser (IS < 1 PD)… *rudbeckiae*

- Scutum punctures denser posteriorly (IS = 1 PD). Metapostnotum strongly extended medially, T1 with sparser punctures laterally (IS > 1 PD). T2 punctures sparser (IS = 1 PD)… *ehnesae*

42 (39). Clypeus and scutum densely punctate (IS < 1 PD) but not reticulate except on anterior border of scutum. T1 with fine dense punctures (IS < 1 PD), interspaces without microsculpture; gonostylus not angled at base, reflexed at apex… *aestivalis* (dark)

- Clypeus and scutum reticulate throughout. T1 with sparse fine punctures (IS > 3 PD), interspaces tessellate; gonostylus angled at base, not reflexed at apex… *andrenoides*

43 (38). Punctures of clypeus large, coarse, shallow and poorly defined. T2 basal impression narrow less than ¾ of disk. … 45

Punctures of clypeus well defined and deep. Labral process broad throughout, apex of labral process 2/3 of base. T2 basal impression deep and broad, approximately ¾ of disk … 44

44. Clypeus with coarse sparse punctures (IS > 1 PD) and strongly impressed median line. Tarsi 2–4 inflated... *citrinifrons*

Clypeus with coarse dense punctures (IS < 1 PD), median impressed line absent or if present very weak. Tarsi 2–4 triangular... *vicina*

45. Labral process strongly tapered, apex 1/3 basal width. T2 basal impression comparatively shallow approximately ½ of disk … *labrosiformis*

- Labral process weakly tapered, apex ¾ basal width.. T2 basal impression narrow and deep, 1/3 of disk … *solidaginis*

Females:

1. Posterior face of propodeum smooth, completely lacking sculpture … 2

- Posterior face of propodeum not smooth, possessing strong macro or microsculpture … 12

2. Scutum punctures minute and 2+ widths apart … 3

- Scutum with larger and more dense punctures (IS < 2 PD) … 7

3. Posterior face of propodeum with no notable microsculpture… 4

- Posterior face of propodeum noticeably microsculptured… 5

4. Scutum sparsely punctate (IS = 1–4 PD), punctures distant from one another except on anterior of disk, and sparsely pubesced; prosternum without conical projection … *illustris*

- Scutum evenly punctured, punctures relatively close (IS = 1–2.5 PD). Pubescence of scutum dense on anterior border. Prosternum with a conical projection … *rudbeckiae*

5. Prosternum not conically projected, face not flattened below antennae, tarsi concolorous...6

- Prosternum conically projected, face flattened below antennae, basitarsis yellow, remaining tarsi dark... *ehnesae*

6. Labral process semicircular and strongly wrinkled. Face with no yellow maculation. Mesopleuron with coarse poorly defined punctures, especially ventrally where it appears rugose. Posterior ventral corner of mesopleuron not notably dulled by tessellation… *albertensis*

- Labral process quadrate and only weakly wrinkled basally. Face with yellow maculation on border of clypeus. Mesopleuron with coarse dense punctures that are well defined even ventrally. Posterior ventral corner of mesopleuron not dulled by tessellation… *irregularis*

7 (2). Large ~ 7–9 mm. Punctures of scutum weak and well spaced on most of disk. Only slightly denser anteriorly. Face appearing long… 8

- Smaller 5–6.5 mm. Punctures of scutum well defined and deep, denser at least on anterior border or along parapsidal lines… 9

8. Face with slight yellow maculation on dorsal margin of clypeus. Scutum punctures denser medially (IS = 1 PD). Pronotal lobes and tibiae at knees yellow. Mesopleuron punctures fine and sparse (IS > 2 PD) absent medially… *amara*

- Face entirely dark. Scutum punctures sparse medially (IS > 2 PD). Pronotal lobes and tibiae dark. Mesopleuron punctures coarse and denser (IS = 1 PD) present medially… *perlaevis*

9 (7). Labral process forked. Mesopleuron dulled by microsculpture… 10

- Labral process not forked. Mesopleuron shining between punctures… 11

10. Pronotal lobes yellow. … *barberi*

- Pronotal lobes dark. … *bidentis*

11. Labral process quadrate and entirely smooth. Scutum punctures fine and uniformly spaced throughout (IS = 1 PD). T2 with dense punctures (IS < 1 PD)… *albipes*

- Labral process triangular and strongly wrinkled. Scutum punctures not uniformly spaced (IS ≥ 1.5 PD). T2 with very fine sparse punctures (IS > 3 PD)… *labrosa*

12 (1). Scutum punctures uniformly dense (IS < 1 PD), well defined and deep … 13

- Scutum punctures sparse (IS > 1 PD) but not always uniform, at least on posterior of disk where they are two or more puncture widths apart often minute and poorly defined… 25

13. Pronotal lobes yellow… 14

- Pronotal lobes dark… 17

14. Scutum pubescence dense, distinct in oblique lateral view. Ventral posterior corner of mesopleuron with microsculpture not obscured by punctures … 15

- Scutum pubescence sparser, short, white, and not easily visible. Ventral posterior corner of mesopleuron microsculpture not obscured by punctures or lacking microsculpture… 16

15. Face usually with yellow maculation on dorsal border of clypeus. Labral process strongly narrowed. Scutum punctures dense (IS < 1 PD). Scutellum densely punctured throughout (IS < 1 PD)… *ornatipes*

- Face completely dark. Labral process slightly narrowed. Scutum punctures sparse (IS = 1 PD). Scutellum laterally impunctate… *quadrapylae*

16. Scutum punctures dense (IS < 1 PD). Scutellum reticulate medially. Non-macrosculptured dorsal area of posterior face of propodeum shining. T1 finely and densely punctate (IS < 1 PD) except along median impunctate line… *alveus* [in part]

- Scutum punctures sparse (IS > 1 PD) medially. Scutellum finely densely punctured medially (IS < 1 PD) but not reticulate. Non-macrosculptured dorsal area of posterior face of propodeum dulled by tessellation. T1 sparsely punctate (IS > 1 PD) throughout… *occidua*

17 (13). Posterior face of propodeum with shining non-sculptured dorsal region… 18

- Posterior face of propodeum sculptured throughout… 21

18. Prosternum lacking conical projection. Scutum not strongly pubescent. T1 noticeably punctate… 19

- Prosternum with a distinct conical projection. Scutum strongly pubescent, hairs often obscuring visibility of punctures. T1 virtually impunctate, punctures barely present and minute… *piercei*

19. Labral process not strongly narrowed and does not have lateral carina. Impunctate space on posterior face of propodeum narrow, less than 1/3 of face… 20

- Labral process strongly narrowed, possessing lateral carina. Impunctate space on posterior face of propodeum broad, approximately 1/3 of face… *labrosiformis*

20. Pronotal lobes carinate. Scutum reticulate anteriorly. T1 finely sparsely punctate (IS = 1 PD)… *alveus* [in part]

- Pronotal lobes rounded. Scutum punctures denser anteriorly, but not reticulate. T1 finely densely punctate (IS < 1 PD) except median impunctate line… *vicina*

21 (17). Scutum punctures with distinct interspaces… 22

- Scutum reticulate-rugose, with no distinct interspaces… *compositarum*

22. Posterior face of propodeum with macrosculpture… 23

- Posterior face of propodeum entirely tessellate with no macrosculpture… *andrenoides*

23. T1 with sparse punctures at least medially… 24

- T1 with dense punctures throughout (IS = 1 PD)… *subtilis*

24. Clypeus and paraocular regions of face densely punctured (IS < 1 PD). Face completely dark. T1 with very sparse fine punctures (IS > 5 PD)… *citripes*

- Clypeus and paraocular regions of face sparsely punctured (IS ≥ 1 PD). Face with yellow maculation on dorsal border of clypeus. T1 with fine dense punctures laterally (IS < 1 PD) but impunctate medially… *vigvierae*

25 (12). Posterior face of propodeum partially shining, usually between the basal wrinkled part and the punctured part of the posterior face… 26

-Posterior face of propodeum entirely dull, either by macrosculpture or microsculpture… 37

26. Scutum with punctures of two kinds, larger more defined punctures, and smaller less visible punctures… 27

-Scutum punctures uniformly sized throughout… 32

27. Wing veins and membrane dark… 28

- Wing veins and membrane pale white… *leucoptera*

28. Posterior face of propodeum with a non-macrosculptured dorsal area… 29

- Posterior face of propodeum entirely macrosculptured… *prata*

29. Clypeus with median impressed line… 30

- Clypeus without median impressed line… 31

30. Clypeus with sparse punctures (IS > 1 PD). Large scutum punctures fine and denser (IS < 2 PD). Metapostnotum weakly extended medially. Non-macrosculptured space on posterior face of propodeum broad (2/3 of PFP)… *citrinifrons*

- Clypeus with dense punctures (IS < 1 PD). Large scutum punctures coarse and sparse (IS > 2 PD). Metapostnotum strongly extended medially. Non-macrosculptured space on posterior face of propodeum narrow (1/3 PFP)… *didirupa*

31. Punctures of scutum uniformly spaced, no more than 3 widths apart posteriorly. Mesopleuron with well defined circular punctures ventro-anteriorly. Scutellum punctures notably crowded medially (IS < 1 PD) and sparser laterally (IS > 1 PD)… *occultata*

- Punctures of scutum not uniform, crowded anteriorly and between parapsidal and medial lines, virtually impunctate posteriorly. Mesopleuron with dense poorly defined punctures, almost ovate. Scutellum punctures dense throughout (IS < 1 PD)… *atricornis*

32. Scutum densely pubescent. Pile long enough to be easily viewed dorsally, and often obscures some portion of scutum… 33

- Scutum weakly pubescent. Pile short and best seen from oblique angle, never obscures scutum… 35

33. Scutum punctures 4+ widths apart posteriorly… 34

- Scutum punctures no more than 3 widths apart posteriorly. Prosternum with a conical projection… *lutzae*

34. Labral process U shaped, strongly narrowed. Mesopleuron with dense punctures (IS ≤ 1.5 PD)... *dracomons*

- Labral process quadrate, not strongly narrowed. Mesopleuron with sparse punctures (IS > 3 PD). *californica*

35 (32). Posterior face of propodeum with punctures throughout. Pronotum either not carinate, or if it is the carination does not extend laterally to the pronotal lobes … 36

- Posterior face of propodeum with thin band of punctures across middle of disk. Pronotum carinate extending to pronotal lobes … *nudescens*

36. T1 punctures dense throughout. Scutum punctures very fine and sparse (IS > 4 PD). Pronotal lobes yellow… *ximenesiae*

- T1 with impunctate median line. Scutum punctures coarser and denser (IS < 3 PD). Pronotal lobes dark…. *luxsolaris*

37 (25). Pronotal lobes angular on anterior border… 38

- Pronotal lobes rounded anteriorly… 39

38. Labral process smooth at base, slightly narrowed to apex. Scutum punctures fine, contiguous on anterior border sparser on disc. Metabasitarsus dark … *aestivalis*

- Labral process wrinkled at base, strongly narrowed strongly to apex. Scutum punctures coarse, distinct interspaces on anterior border. Metabasitarsus (usually) yellow… *albitarsis*

39. Labral process broadly rectangular broader than long. Clypeus with dense punctures throughout, and no colouration. Scutum punctures dense anteriorly to the point that there are no interspaces between them … *solidaginis*

- Labral process square, about equal in length and width. Clypeus with dense punctures laterally, separated in middle by impunctate area, clypeus possessing yellow maculation that extends into supraclypeal area. Scutum punctures always with at least 1 width between them, even on anterior border where crowded … *renimaculata*

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Table 1. Floral records of *Protandrena aestivalis.*

Family	Tribe	Genus	Species	Male	Female	Source

Asteraceae			sp.		14	Label data
Asteraceae	Astereae	*Boltonia*	*asteroides*	1		Label data
Asteraceae	Astereae	*Chrysopsis*	sp.	1		Label data
Asteraceae	Astereae	*Chrysopsis*	*villosa*			Stevens 1950
Asteraceae	Astereae	*Erigeron*	sp.		1	Label data
Asteraceae	Astereae	*Erigeron*	*annuus*		1	Label data
Asteraceae	Astereae	*Erigeron*	*philadelphicus*	1		Label data
Asteraceae	Astereae	*Eurybia*	*macrophylla*	1	6	Label data
Asteraceae	Astereae	*Grindelia*	*squarrosa*	7	4	Label data, Stevens 1950
Asteraceae	Astereae	*Heterotheca*	*latifolia*		1	Label data

Asteraceae	Astereae	*Heterotheca*	*subaxillaris*	1		Label data
Asteraceae	Astereae	*Heterotheca*	*villosa*			Stevens 1950
Asteraceae	Astereae	*Solidago*	sp.	43		Hurd 1979, Label data
Asteraceae	Astereae	*Solidago*	*canadensis*		5	Label data, Stevens 1950
Asteraceae	Astereae	*Solidago*	*juncea*		3	Label data
Asteraceae	Chicorieae	*Sonchus*	sp.		1	Label data
Asteraceae	Chicorieae	*Taraxacum*	*officinale*		1	Label data
Asteraceae	Heliantheae	*Helianthus*	*grosseserratus*	1		Label data
Asteraceae	Heliantheae	*Verbesina*	sp.		1	Label data

Convolvulaceae	*Cuscuta*	*gronovii*	Stevens 1950
Fabaceae	*Dalea*	*candida var oligophylla*	Stevens 1950
Polygonaceae	*Eriogonum*	*annuum*	Stevens 1950

Stevens 1950 did not provide numbers of specimens per host plant.

Table 2. Floral records of *Protandrena albertensis.*

Family	Tribe	Genus	Species	Male	Female	Source
Asteraceae	Chicoreae	*Latuca*	*tatarica*	1	1	Label data
Asteraceae	Chicoreae	*Sonchus*	*arvensis*	2	2	Label data

Table 3. Floral records of *Protandrena albitarsis*. Records of females collecting pollen are indicated with (P).

Family	Tribe	Genus	Species	Male	Female	Source
Amaryllidaceae		*Allium*	sp.	1		Label data
Apiaciae		*Heracleum*	maximum		1	Label data
Apocynaceae	Apocyneae	*Apocynum*	sp.		1	Label data

Apocynaceae	Asclepiadeae	*Asclepias*	sp.		1	Label data
Asteraceae		*Dracopis*	*amplexicaulis*	1		Label data
Asteraceae	Astereae	*Agoseris*	*glauca*			Stevens 1950
Asteraceae	Astereae	*Centaurea*	*jacea*		2	Label data, Stevens 1950
Asteraceae	Astereae	*Erigeron*	*formosissimus*	1		Label data
Asteraceae	Astereae	*Erigeron*	*speciosus*	5	5	Label data
Asteraceae	Astereae	*Grindelia*	sp.		1	Label data
Asteraceae	Astereae	*Grindelia*	*squarrosa*			Stevens 1950
Asteraceae	Astereae	*Symphyotrichum*	sp.		1	Label data

Asteraceae	Astereae	*Symphyotrichum*	*pilosum*		1		Hurd 1979, Robertson 1922
Asteraceae	Chicorieae	*Taraxaxum*	*officinale*				Stevens 1950
Asteraceae	Coreopsideae	*Coreopsis*	*lanceolata*	1	1		Label data
Asteraceae	Coreopsideae	*Coreopsis*	*palmata*				Hurd 1979, Robertson 1922
Asteraceae	Coreopsideae	*Coreopsis*	*tinctoria*		1		Label data
Asteraceae	Coreopsideae	*Thelesperma*	*filifolium*		7		Label data
Asteraceae	Helenieae	*Amblyolepis*	*setigera*			1	Label data
Asteraceae	Helenieae	*Gaillardia*	sp.		11		Label data

Asteraceae	Helenieae	*Gaillardia*	*aristata*	19	16	Label data, Stevens 1950
Asteraceae	Helenieae	*Hymenoxys*	*hoopesii*	16	18	Label data
Asteraceae	Heliantheae	*Echinacea*	*angustifolia*	1		Label data, Stevens 1950
Asteraceae	Heliantheae	*Echinacea*	*pallida*	9	7 (1P)	Hurd 1979, Robertson 1922
Asteraceae	Heliantheae	*Echinacea*	*purpurea*		(1P)	Hurd 1979, Robertson 1922
Asteraceae	Heliantheae	*Engelmannia*	*peristenia*	1		Label data
Asteraceae	Heliantheae	*Engelmannia*	*pinnatifida*	37	28	Label data

Asteraceae	Heliantheae	*Helianthus*	sp.	21	11	Hurd 1979, Label data
Asteraceae	Heliantheae	*Helianthus*	*annuus*	26	12	Cockerell 1914, Label data, Stevens 1950
Asteraceae	Heliantheae	*Helianthus*	*bolanderi*	1		Label data
Asteraceae	Heliantheae	*Helianthus*	*divaricatus*	(1)	(1P)	Hurd 1979, Robertson 1922
Asteraceae	Heliantheae	*Helianthus*	*hirsutus*	1	1	Label data
Asteraceae	Heliantheae	*Helianthus*	*maximiliani*	6	6	Label data,

						Stevens 1950
Asteraceae	Heliantheae	*Helianthus*	*mollis*	1	(1P)	Hurd 1979, Robertson 1922
Asteraceae	Heliantheae	*Helianthus*	*nuttallii rydbergii*			Stevens 1950
Asteraceae	Heliantheae	*Helianthus*	*petiolaris*	2	6	Label data, Stevens 1950
Asteraceae	Heliantheae	*Helianthus*	*pumilus*	1	1	Label data
Asteraceae	Heliantheae	*Helianthus*	*rigidus*			Stevens 1950
Asteraceae	Heliantheae	*Helianthus*	*strumosus*	1		Label data
Asteraceae	Heliantheae	*Helianthus*	*tuberosus*			Stevens 1950

Asteraceae	Heliantheae	*Heliomeris*	*multiflora* var. *nevadensis*		3	Label data
Asteraceae	Heliantheae	*Ratibida*	sp.	1	1	Label data
Asteraceae	Heliantheae	*Ratibida*	*pinnata*	14	12	Label data, Stevens 1950
Asteraceae	Heliantheae	*Ratibida*	*pinnata*		(1)	Hurd 1979, Robertson 1922
Asteraceae	Heliantheae	*Rudbeckia*	sp.	3		Label data
Asteraceae	Heliantheae	*Rudbeckia*	*hirta*	10	7(1P)	Hurd 1979, Label data, Robertson 1922

Asteraceae	Heliantheae	*Rudbeckia*	*laciniata*	(1)	(1P)	Hurd 1979, Robertson 1922
Asteraceae	Heliantheae	*Rudbeckia*	*submentosa*	(1)	(1P)	Hurd 1979, Robertson 1922
Asteraceae	Heliantheae	*Rudbeckia*	*triloba*	1		Label data
Asteraceae	Heliantheae	*Verbesina*	*helianthoides*		(1P)	Hurd 1979, Robertson 1922
Asteraceae	Heliantheae	*Viguiera*	sp.		1	Label data
Fabaceae		*Dalea*	*candida*		1	Label data
Fabaceae		*Meliotus*	*officinalis*		1	Label data
Malvaeae		*Sphaeralcea*	sp.	1	1	Label data

Onagraceae	*Calylophus*	*serrulatus*	1		Label data, Stevens 1950
Onagraceae	*Oenothera*	*serrulata*	1		Label data
Rosaceae	*Chamaebatiaria*	*millefolium*		1	Label data
Solanaceae	*Quincula*	*lobata*	1		Label data

Table 4. Floral records of *Protandrena alveus*.

Family	Tribe	Genus	Species	Male	Female	Source
Asteraceae	Astereae	*Croptilon*	*divaricatum*		9	Label data
Asteraceae	Astereae	*Heterotheca*	*subaxillaris*		10	Label data

Table 5. Floral records of *Protandrena andrenoides*. Records of females collecting pollen are indicated with (P).

Family	Tribe	Genus	Species	Male	Female	Source
Asteraceae	Astereae	*Eurybia*	*macrophylla*	3	1	Label data
Asteraceae	Astereae	*Doellingeria*	*umbellata*		1	Label data

Asteraceae	Astereae	*Solidago*	sp.	107	80	Hurd 1979, Label data
Asteraceae	Astereae	*Solidago*	*canadensis*	3	3(1P)	Label data, Robertson 1922, Stevens 1950
Asteraceae	Astereae	*Symphyotrichum*	sp.	1	1	Hurd 1979
Asteraceae	Astereae	*Symphyotrichum*	*sempervirens*	1	1	Label data
Asteraceae	Astereae	*Symphyotrichum*	*lanceolatum*	2		Label data, Stevens 1950
Asteraceae	Astereae	*Symphyotrichum*	*lateriflorum*	3	(1P)	Label data, Robertson 1922
Asteraceae	Astereae	*Symphyotrichum*	*nemoralis*		(1P)	Robertson 1922

Asteraceae	Astereae	*Symphyotrichum*	*pilosum*		(1P)	Robertson 1922
Asteraceae	Astereae	*Symphyotrichum*	*prenanthoides*	1		Label data
Asteraceae	Astereae	*Symphyotrichum*	*sagittifolium*		(1P)	Robertson 1922
Asteraceae	Astereae	*Symphyotrichum*	*serotina*			Robertson 1922
Asteraceae	Astereae	*Symphyotrichum*	*ulmifolia*	(1)	(1P)	Robertson 1922
Asteraceae	Heliantheae	*Rudbeckia*	*laciniata*			Stevens 1950
Asteraceae	Heliantheae	*Rudbeckia*	*triloba*		(1P)	Hurd 1979, Robertson 1922

Table 6. Floral records of *Protandrena amor*

Family	Tribe	Genus	Species	Male	Female	Source
Asteraceae	Heliantheae	*Verbesina*	*virginica*	1		Label data
Asteraceae	Heliantheae	*Vigiuera*	*dentata*		1	Label data

Table 7. Floral records of *Protandrena atricornis.*

Family	Tribe	Genus	Species	Male	Female	Source
Apiaceae		*Eryngium*	*heterophyllum*		1	Label data
Asteraceae			sp.	9	14	Label data
Asteraceae	Anthemideae	*Achillea*	*millefolium*	1	1	Label data
Asteraceae	Astereae	*Erigeron*	sp.	6	5	Label data
Asteraceae	Astereae	*Erigeron*	*arizonicus*	3		Label data
Asteraceae	Astereae	*Erigeron*	*divergens*	1	1	Label data
Asteraceae	Astereae	*Erigeron*	*flagellaris*	1	1	Label data
Asteraceae	Astereae	*Erigeron*	*formosissimus*	34	45	Label data
Asteraceae	Astereae	*Erigeron*	*neomexicanus*		1	Label data
Asteraceae	Astereae	*Erigeron*	*oreophilus*		2	Label data

Asteraceae	Astereae	*Erigeron*	*speciosus*	1		Label data
Asteraceae	Astereae	*Erigeron*	*subtrinervis*	18	52	Label data
Asteraceae	Astereae	*Gutierrezia*	*wrightii*		9	Label data
Asteraceae	Astereae	*Symphyotrichum*	sp.	1		Label data
Asteraceae	Astereae	*Symphyotrichum*	*divergens*	1	1	Label data
Asteraceae	Astereae	*Symphyotrichum*	*neomexicanus*		1	Label data
Asteraceae	Astereae	*Symphyotrichum*	*oreophilus*		2	Label data
Asteraceae	Bahieae	*Hymenopappus*	*newberryi*		1	Label data
Asteraceae	Heliantheae	*Heliomeris*	*multiflora* var. *nevadensis*		2	Label data
Asteraceae	Heliantheae	*Verbesina*	sp.		1	Label data
*Campanula*ceae		*Campanula*	*rotundifolia*	1		Label data

Geraniaceae	*Geranium*	sp.	1		Label data
Lamiaceae	*Salvia*	sp.	6		Label data
Rosaceae	*Potentilla*	*hippiana*		1	Label data

Table 8. Floral records of *Protandrena barberi.*

Family	Tribe	Genus	Species	Male	Female	Source
Asteraceae	Astereae	*Erigeron*	*neomexicanus*		1	Label data
Asteraceae	Coreopsideae	*Bidens*	*alba radiata*	3		Label data
Asteraceae	Coreopsideae	*Cosmos*	*parviflorus*	1	1	Label data
Asteraceae	Heliantheae	*Verbesina*	*encelioides*	2	4	Label data
Asteraceae	Heliantheae	*Verbesina*	*virginica*	1	1	Label data
Lamiaceae		*Salvia*	sp.	1		Label data

Table 9. Floral records of *Protandrena boylei*.

Family	Tribe	Genus	Species	Male	Female	Source
Cleomaceae		*Cleome*	sp.			Cockerell 1896b

Table 10. Floral records of *Protandrena californica*.

Family	Tribe	Genus	Species	Male	Female	Source
Asteraceae	Chaenactideae	*Chaenactis*	*glabriuscula*			Hurd 1979
Asteraceae	Coreopsidieae	*Coreopsis*	*maritima*	1		Label data
Asteraceae	Heliantheae	*Encelia*	*californica*			Hurd 1979
Asteraceae	Madieae	*Lasthenia*	*californica*			Hurd 1979
Asteraceae	Madieae	*Layia*	*elegans*	1		Hurd 1979, Label data
Asteraceae	Madieae	*Layia*	*gracils*			Hurd 1979
Asteraceae	Madieae	*Layia*	*platyglossa*			Hurd 1979

Polemoniaceae	*Gilia*	*achilleifolia multicaulis*	Hurd 1979
Ranunculaceae	*Ranunculus*	*californicus*	Hurd 1979

Table 11. Floral records of *Protandrena citrinifrons*.

Family	Tribe	Genus	Species	Male	Female	Source
Asteraceae	Astereae	*Erigeron*	sp.	7	9	Label data
Asteraceae	Astereae	*Erigeron*	*neomexicanus*	11	1	Label data
Asteraceae	Astereae	*Gutierrezia*	*wrightii*	4	1	Label data
Asteraceae	Astereae	*Solidago*	*wrightii*	1	1	Label data
Asteraceae	Coreopsideae	*Cosmos*	*parviflorus*	1		Label data
Asteraceae	Gnaphalieae	*Gnaphalium*	*pringlei*	2		Label data
Asteraceae	Heliantheae	*Heliopsis*	*parvifolia*	1		Label data

Geraniaceae	*Geranium*	*richardsonii*	2		Label data
Lamiaceae	*Salvia*	sp.	1		Label data

Table 12. Floral records of *Protandrena citripes*.

Family	Tribe	Genus	Species	Male	Female	Source
Asteraceae	Astereae	*Erigeron*	divergens	1		Label data
Asteraceae	Astereae	*Erigeron*	*tracyi*	1		Label data
Asteraceae	Astereae	*Grindelia*	*squarrosa*	1		Label data
Asteraceae	Astereae	*Heterotheca*	sp.	11		Label data
Asteraceae	Astereae	*Heterotheca*	*subaxillaris*	2	1	Label data
Asteraceae	Helenieae	*Helenium*	sp.	1		Label data

Table 13. Floral records of *Protandrena compositarum*. Records of females collecting pollen are indicated with (P).

Family	Tribe	Genus	Species	Male	Female	Source
Asteraceae	Astereae	*Amphiachyris*	sp.		1	Label data
Asteraceae	Astereae	*Amphiachyris*	*dracunuloides*		2	Label data

Asteraceae	Astereae	*Boltonia*	*asteroides*		(1P)	Hurd 1979, Robertson 1922
Asteraceae	Astereae	*Solidago*	sp.		4	Label data
Asteraceae	Astereae	*Solidago*	*canadensis*		1	Label data
Asteraceae	Astereae	*Solidago*	*nemoralis*		1	Hurd 1979
Asteraceae	Astereae	*Solidago*	*ulmifolia*		(1P)	Hurd 1979, Robertson 1922
Asteraceae	Astereae	*Symphyotrichum*	sp.	1	14	Hurd 1979, Label data
Asteraceae	Astereae	*Symphyotrichum*	*dumosum*			Owens et al. 2018

Asteraceae	Astereae	*Symphyotrichum*	*ericoides*		2 (1P)	Robertson 1922
Asteraceae	Astereae	*Symphyotrichum*	*lanceolatum*		(1P)	Robertson 1922
Asteraceae	Astereae	*Symphyotrichum*	*lateriflorum*		(1P)	Robertson 1922
Asteraceae	Astereae	*Symphyotrichum*	*novae-angliae*		1 (1P)	Robertson 1922
Asteraceae	Astereae	*Symphyotrichum*	*ontarionis*	1	1	Label data
Asteraceae	Astereae	*Symphyotrichum*	*pilosum*	24	132 (1P)	Robertson 1922
Asteraceae	Astereae	*Symphyotrichum*	*prealtum*		1	Label data
Asteraceae	Astereae	*Symphyotrichum*	*prenanthoides*		1	Label data
Asteraceae	Astereae	*Symphyotrichum*	*racemosum*		17	Label data
Asteraceae	Astereae	*Symphyotrichum*	*subulatum*		4	Label data
Asteraceae	Coreopsideae	*Bidens*	*aristosa*			Hurd 1979

Asteraceae	Coreopsideae	*Bidens*	*trichosperma*	1		Label data
Asteraceae	Heliantheae	*Rudbeckia*	*triloba*			Hurd 1979
Polygonaceae		*Polygonum*	*scandens*			Hurd 1979

Table 14. Floral records of *Protandrena didirupa.*

Family	Tribe	Genus	Species	Males	Females	Source
Asteraceae	Anthemideae	*Achillea*	*millefolium*	1		Label data
Asteraceae			sp.	1		Label data
Asteraceae	Astereae	*Chrysothamnus*	sp.	1		Label data
Asteraceae	Astereae	*Chrysothamnus*	*depressus*	2	2	Label data
Asteraceae	Astereae	*Erigeron*	*canus*		3	Label data
Asteraceae	Astereae	*Grindelia*	sp.	2	6	Label data

Asteraceae	Astereae	*Gutierrezia*	*sarothrae*	2	1	Label data
Asteraceae	Astereae	*Heterotheca*	*villosa*		8	Label data
Asteraceae	Astereae	*Solidago*	sp.		1	Label data
Asteraceae	Astereae	*Symphyotrichum*	sp.	1	1	Label data
Asteraceae	Cardueae	*Cirsium*	sp.		1	Label data
Asteraceae	Heliantheae	*Heliomeris*	*multiflora*	1		Label data
Asteraceae	*Senecio*neae	*Erechtites*	*sonchoides*	1		Label data
Asteraceae	*Senecio*neae	*Senecio*	*spartiodes*		1	Label data

Table 15. Floral records of *Protandrena illustris.*

Family		Genus	Species	Males	Females	Source
Asteraceae	Heliantheae	*Helianthus*	*annuus*	1	1	Label data

Asteraceae	Heliantheae	*Helianthus*	*petiolaris*		2	Label data
Asteraceae	Heliantheae	*Verbesina*	*encelioides*	5	10	Hurd 1979, Label data
Asteraceae	Heliantheae	*Viguiera*	sp.			Hurd 1979
*Campanula*ceae		*Campanula*	*rotundifolia*		1	Label data
Fabaceae		*Dalea*	*polygonoides*		1	Label data

Table 16. Floral records of *Protandrena irregularis*.

Family	Tribe	Genus	Species	Males	Females	Source
Asteraceae			sp.	1		Label data
Asteraceae	Astereae	*Chrysothamnus*	sp.	1		Label data
Asteraceae	Astereae	*Grindelia*	sp.	2	3	Label data
Asteraceae	Astereae	*Grindelia*	*squarrosa*	3		Label data
Asteraceae	Astereae	*Gutierrezia*	*sarothrae*	1		Label data
Asteraceae	Astereae	*Heterotheca*	sp.	1		Label data
Asteraceae	Astereae	*Heterotheca*	*villosa*	7		Label data

Asteraceae	Astereae	*Heliomeris*	*multiflora*	2		Label data

Table 17. Floral records of *Protandrena labrosiformis*. Records of females collecting pollen are indicated with (P).

Family	Tribe	Genus	Species	Male	Female	Source
Asteraceae	Astereae	*Solidago*	*canadensis*	(1)		Hurd 1979, Robertson 1922
Asteraceae	Coreopsideae	*Bidens*	*aristosa*		(1P)	Hurd 1979, Robertson 1922
Asteraceae	Coreopsideae	*Coreopsis*	*tripteris*	(1)	(1)	Hurd 1979, Robertson 1922
Asteraceae	Heliantheae	*Helianthus*	*divaricatus*	(1)	(1P)	Hurd 1979, Robertson 1922
Asteraceae	Heliantheae	*Helianthus*	*grosseserratus*	2		Label data
Asteraceae	Heliantheae	*Helianthus*	*strumosus*		(1)	Robertson 1922

Asteraceae	Heliantheae	*Helianthus*	*tuberosus*	(1)	(1P)	Hurd 1979, Robertson 1922
Asteraceae	Heliantheae	*Heliopsis*	*helianthoides*	(1)	(1P)	Hurd 1979, Robertson 1922
Asteraceae	Heliantheae	*Rudbeckia*	*laciniata*	(1)	(1P)	Hurd 1979, Robertson 1922
Asteraceae	Heliantheae	*Rudbeckia*	*triloba*		(1P)	Hurd 1979, Robertson 1922
Asteraceae	Heliantheae	*Silphium*	*perfoliatum*	(1)		Hurd 1979, Robertson 1922
Asteraceae	Heliantheae	*Verbesina*	*alternifolia*			Hurd 1979
Asteraceae	Heliantheae	*Verbesina*	*encelioides*		(1P)	Robertson 1922

Table 18. Floral records of *Protandrena labrosa*. Records of females collecting pollen are indicated with (P).

Family	Genus	Species	Males	Females	Source

Asteraceae	Eupatorieae	*Eupatorium*	*rugosum*		1	Label data
Asteraceae	Heliantheae	*Helianthus*	*divaricatus*	(1)	(1P)	Hurd 1979, Robertson 1922
Asteraceae	Heliantheae	*Helianthus*	*grosseserratus*		1	Label data
Asteraceae	Heliantheae	*Helianthus*	*maximilianus*		1	Label data
Asteraceae	Heliantheae	*Helianthus*	*occidentalis*		1	
Asteraceae	Heliantheae	*Helianthus*	*tuberosus*	(2)	(2 + 1P)	Hurd 1979, Robertson 1922
Asteraceae	Heliantheae	*Heliopsis*	sp.			Hurd 1979
Asteraceae	Heliantheae	*Rudbeckia*	sp.	1	2	Label data
Asteraceae	Heliantheae	*Rudbeckia*	*laciniata*		1 (1)	Hurd 1979, Label data, Robertson 1922
Asteraceae	Heliantheae	*Rudbeckia*	*triloba*	(1)	4 (1P)	Hurd 1979, Label data, Robertson 1922
Asteraceae	Heliantheae	*Silphium*	*perfoliatum*	1		Label data

Table 19. Floral records of *Protandrena leucoptera*.

Family	Tribe	Genus	Species	Males	Females	Source
Asteraceae	Heliantheae	*Helianthus*	sp.	3		Label data
Asteraceae	Heliantheae	*Helianthus*	*annuus*	1		Label data
Asteraceae	Heliantheae	*Helianthus*	*petiolaris*	4		Label data

Table 20. Floral records of *Protandrena lutzae*.

Family	Tribe	Genus	Species	Males	Females	Source
Asteraceae	Heliantheae	*Verbesina*	sp.		5	Label data

Table 21. Floral records of *Protandrena luxsolaris*.

Family	Tribe	Genus	Species	Males	Females	Source
Asteraceae	Astereae	*Erigeron*	*filifolius*	1		Label data

Table 22. Floral records of *Protandrena nudescens*.

Family	Tribe	Genus	Species	Males	Females	Source
Asteraceae	Astereae	*Chrysopsis*	*villosa*	1	2	Label data
Asteraceae	Astereae	*Grindelia*	*squarrosa*	2		Label data
Asteraceae	Astereae	*Machaerenthera*	*tanacetifolia*	1		Label data

Table 23. Floral records of *Protandrena occidua*. Records of females collecting pollen are indicated with (P).

Family	Tribe	Genus	Species	Male	Female	Source
Asteraceae	Astereae	*Erigeron*	*divergens*	2	1	Label data
Asteraceae	Astereae	*Haplopappus*	sp.	(1)	1 (7)	Label data, Timberlake 1967
Asteraceae	Astereae	*Heterotheca*	sp.	2	2 (12)	Label data, Timberlake 1967
Asteraceae	Astereae	*Heterotheca*	*subaxillaris*	3 (2)	2 (1 + 1P)	Hurd 1979, Label data, Timberlake 1967
Asteraceae	Astereae	*Xanthisma*	*gracile*	(1)	(4 (P))	Hurd 1979, Timberlake 1967
Asteraceae	Heliantheae	*Helianthus*	sp.		(1 + 1P)	Hurd 1979
Asteraceae	Heliantheae	*Verbesina*	*encelioides*	(1)	(P)	Hurd 1979, Timberlake 1967
Fabaceae		*Lotus?*	sp.	(1)		Timberlake 1967

Table 24. Floral records of *Protandrena occultata*.

Family	Tribe	Genus	Species	Male	Female	Source
Asteraceae			sp.	1		Label data
Asteraceae	Astereae	*Erigeron*	sp.		1	Label data
Asteraceae	Astereae	*Erigeron*	*neomexicanus*		1	Label data
Asteraceae	Astereae	*Heterotheca*	sp.	1		Label data
Asteraceae	Heliantheae	*Verbesina*	*encelioides*	4	1 (P)	Hurd 1979, Label data

Table 25. Floral records of *Protandrena ornatipes*.

Family	Tribe	Genus	Species	Male	Female	Source
Asteraceae	Astereae	*Amphiachyris*	sp.		2	Label data
Asteraceae	Astereae	*Amphiachyris*	*dracunuloides*	3	1	Label data
Asteraceae	Astereae	*Baccharis*	sp.		1	Label data
Asteraceae	Astereae	*Chrysothamnus*	sp.		2	Label data
Asteraceae	Astereae	*Chrysothamnus*	*depressus*		2	Label data
Asteraceae	Astereae	*Croptilon*	*divaricatum*		1	Label data

Asteraceae	Astereae	*Dieteria*	*canescens*		1	Label data
Asteraceae	Astereae	*Ericameria*	sp.		1	Label data
Asteraceae	Astereae	*Erigeron*	sp.		1	Label data
Asteraceae	Astereae	*Gutierrezia*	sp.	1	17	Label data
Asteraceae	Astereae	*Gutierrezia*	*sarothrae*		17	Label data
Asteraceae	Astereae	*Solidago*	sp.	1		Label data
Asteraceae	Astereae	*Symphyotrichum*	sp.		1	Label data
Asteraceae	Coreopsideae	*Thelesperma*	*filifolium*		1	Label data
Asteraceae	Helenieae	*Helenium*	*amarum badium*	2	2	Label data
Asteraceae	Heliantheae	*Engelmannia*	*pinnatifida*		3	Label data
Asteraceae	Tageteae	*Dyssodia*	sp.		1	Label data

Malvaceae		*Sphaeralcea*	sp.	4	2	Label data

Table 26. Floral records of *Protandrena perlaevis*. Records of females collecting pollen are indicated with (P).

Family	Tribe	Genus	Species	Male	Female	Source
Asteraceae	Astereae	*Grindelia*	*squarrosa*		1	Label data, Stevens 1950
Asteraceae	Chicorieae	*Agoseris*	*glauca*		1	Label data
Asteraceae	Heliantheae	*Helianthus*	sp.	4	44	Label data, Stevens 1950
Asteraceae	Heliantheae	*Helianthus*	*annuus*	4	6 (3 + 1P)	Hurd 1979, Hurd et al. 1980, Label data,

						Mitchell 1960
Asteraceae	Heliantheae	*Helianthus*	*divaricatus*	1		Label data
Asteraceae	Heliantheae	*Helianthus*	*grosseserratus*	1		Label data
Asteraceae	Heliantheae	*Helianthus*	*lenticularis*	1		Label data
Asteraceae	Heliantheae	*Helianthus*	*maximiliani*	4	5	Label data
Asteraceae	Heliantheae	*Helianthus*	*pauciflorus*	1	3	Label data
Asteraceae	Heliantheae	*Helianthus*	*petiolaris*	5 (3)	1 (2 + 1P)	Hurd et al. 1980, Label data
Asteraceae	Heliantheae	*Helianthus*	*tuberosus*		1	Label data
Asteraceae	Heliantheae	*Silphium*	*terebinthinaceum*	1		Label data

Table 27. Floral records of *Protandrena piercei*.

Family	Tribe	Genus	Species	Male	Female	Source
Asteraceae	Astereae	*Grindelia*	*squarrosa*	6	2	Label data, Stevens 1950
Asteraceae	Astereae	*Solidago*	*rigida*	1		Label data, Stevens 1950
Asteraceae	*Chicorieae*	*Taraxacum*	*officinale*		1	Label data
Asteraceae	Heliantheae	*Helianthus*	sp.		4	Stevens 1950
Asteraceae	Heliantheae	*Helianthus*	*annuus*		1	Label data
Asteraceae	Heliantheae	*Helianthus*	*maximiliani*	1	2	Label data
Asteraceae	Heliantheae	*Helianthus*	*petiolaris*		1	Label data

Table 28. Floral records of *Protandrena quadrapylae.*

Family	Tribe	Genus	Species	Male	Female	Source
Asteraceae	Astereae	*Amphiachyris*	*dracunuloides*	1	1	Label data
Asteraceae	Astereae	*Symphyotrichum*	*subulatum*		2	Label data
Asteraceae	Astereae	*Gutierrezia*	sp.	1		Label data

Table 29. Floral records of *Protandrena renimaculata*.

Family	Tribe	Genus	Species	Male	Female	Source
Asteraceae			sp.		1	Label data
Asteraceae	Astereae	*Boltonia*	*asteroides* var. *latisquama*			Stevens 1950
Asteraceae	Astereae	*Callistephus*	*chinensis*		1	Label data, Stevens 1950
Asteraceae	Astereae	*Chrysothamnus*	sp.	1	1	Label data
Asteraceae	Astereae	*Ericameria*	*nauseosa*		1	Label data
Asteraceae	Astereae	*Grindelia*	sp.		3	Label data
Asteraceae	Astereae	*Grindelia*	*squarrosa*	16	32	Label data
Asteraceae	Astereae	*Gutierrezia*	*sarothrae*		1	Label data
Asteraceae	Astereae	*Solidago*	*canadensis*		1	Label data

Asteraceae	Astereae	*Symphyotrichum*	sp.	1	4	Label data
Asteraceae	Astereae	*Symphyotrichum*	*chilense*		1	Label data
Asteraceae	Astereae	*Symphyotrichum*	*ericoides*		2	Label data, Stevens 1950
Asteraceae	Astereae	*Symphyotrichum*	*lanceolatum lanceolatum*		1	Label data, Stevens 1950
Asteraceae	Chaenactideae	*Chaenactis*	*stevioides*	1		Label data
Asteraceae	Heliantheae	*Helianthus*	sp.		2	Label data
Asteraceae	Heliantheae	*Helianthus*	*annuus*		3	Label data
Asteraceae	Heliantheae	*Helianthus*	*maximiliani*		1	Label data
Asteraceae	Heliantheae	*Helianthus*	*petiolaris*	1	2	Label data,

						Stevens 1950
Asteraceae	Heliantheae	*Heterotheca*	*subaxillaris*	1		Label data
Asteraceae	Heliantheae	*Heterotheca*	*villosa*		1	Label data
Asteraceae	Heliantheae	*Rudbeckia*	*laciniata*			Stevens 1950
Asteraceae	Heliantheae	*Verbesina*	sp.	1	1	Label data
Asteraceae	Heliantheae	*Viguiera*	sp.		2	Label data

Table 30. Floral records of *Protandrena rowellae*.

Family	Tribe	Genus	Species	Males	Females	Source
Asteraceae	Heliantheae	*Heliomeris*	*multiflora nevadensis*	8		Label data

Table 31. Floral records of *Protandrena rudbeckiae*. Records of females collecting pollen are indicated with (P).

Family	Tribe	Genus	Species	Male	Female	Source
Asteraceae	Astereae	*Symphyotrichum*	sp.			Hurd 1979

Asteraceae	Coreopsideae	*Bidens*	*aristosa*	(1)	(1P)	Hurd 1979, Robertson 1922
Asteraceae	Heliantheae	*Helianthus*	*divaricatus*	(1)		Hurd 1979, Robertson 1922
Asteraceae	Heliantheae	*Rudbeckia*	*hirta*	1 (1)	(1P)	Hurd 1979, Label data, Robertson 1922
Asteraceae	Heliantheae	*Rudbeckia*	*laciniata*	(1)	(1P)	Hurd 1979, Robertson 1922
Asteraceae	Heliantheae	*Rudbeckia*	*submentosa*	(1)	(1P)	Hurd 1979, Robertson 1922

Asteraceae	Heliantheae	*Rudbeckia*	*triloba*	1 (1)	2 (1P)	Hurd 1979, Label data, Robertson 1922

Table 32. Floral records of *Protandrena skeggox*.

Family	Tribe	Genus	Species	Male	Female	Source
Asteraceae	Tageteae	*Adenophyllum*	*glandulosum*	1		Label data
Asteraceae	Tageteae	*Thymophylla*	*concinna*	1		Label data

Table 33. Floral records of Protandrena solidaginis. Records of females collecting pollen are indicated with (P).

Family	Tribe	Genus	Species	Male	Female	Source
Asteraceae	Astereae	*Boltonia*	*asteroides*		(1P)	Hurd 1979, Robertson 1922
Asteraceae	Astereae	*Solidago*	*canadensis*	(1)	(1P)	Hurd 1979, Robertson 1922
Asteraceae	Coreopsideae	*Bidens*	*aristosa*	2 (1)	3	Hurd 1979, Label data,

						Robertson 1922
Asteraceae	Coreopsideae	*Bidens*	*polylepis*		1	Label data
Asteraceae	Coreopsideae	*Coreopsis*	*tripteris*	(1)		Hurd 1979, Robertson 1922
Asteraceae	Helenieae	*Helenium*	*virginicum*		1	Label data
Asteraceae	Heliantheae	*Helianthus*	sp.	1		Label data
Asteraceae	Heliantheae	*Helianthus*	*grosserratus*	(1)	(1P)	Hurd 1979, Robertson 1922
Asteraceae	Heliantheae	*Helianthus*	*tuberosus*	(1)		Hurd 1979, Robertson 1922
Asteraceae	Heliantheae	*Rudbeckia*	*submentosa*	(1)	(1P)	Hurd 1979, Robertson 1922

Table 34. Floral records of *Protandrena vicina*. Records of females collecting pollen are indicated with (P).

Family	Tribe	Genus	Species	Male	Female	Source

Asteraceae	Astereae	*Xanthisma*	*gracile*	(2)	Hurd 1979, Timberlake 1967

Table 35. Floral records of *Protandrena ximenesiae*. Records of females collecting pollen are indicated with (P).

Family	Genus	Species	Male	Female	Source
Asteraceae	*Verbesina*	*encelioides*		(1)	Cockerell 1913

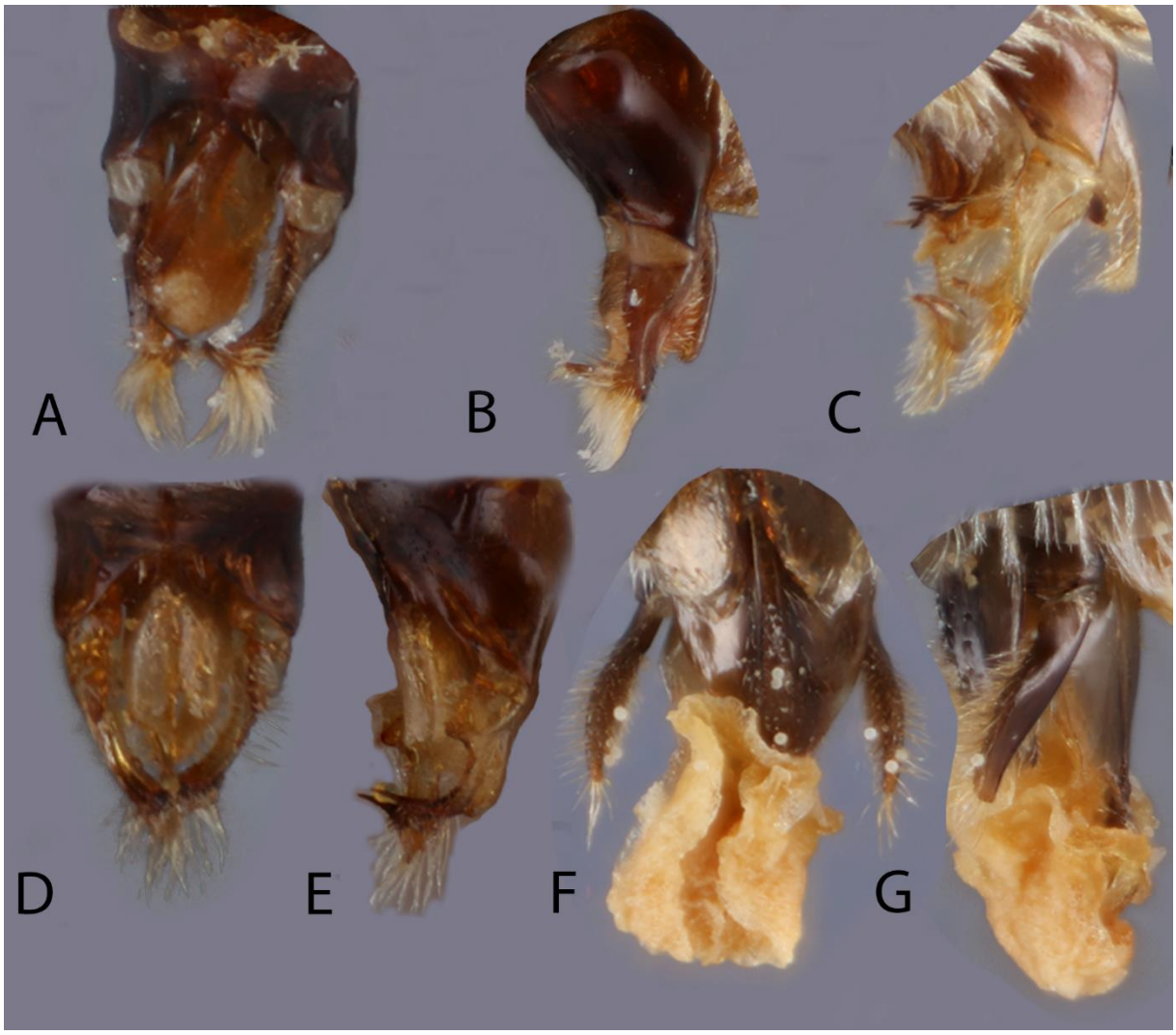


Figure 124. Genitalia of *Pterosarus* males. **A.** *Pr.* (*Pt.*) *aestivalis* dorsal. **B.** *Pr.* (*Pt.*) *aestivalis* lateral. **C.** *Pr.* (*Pt.*) *albertensis* lateral. **D.** *Pr.* (*Pt.*) *albipes* dorsal. **E.** *Pr.* (*Pt.*) *albipes* lateral. **F.** *Pr.* (*Pt.*) *albitarsis* ventral. **G.** *Pr.* (*Pt.*) *albitarsis* lateral.

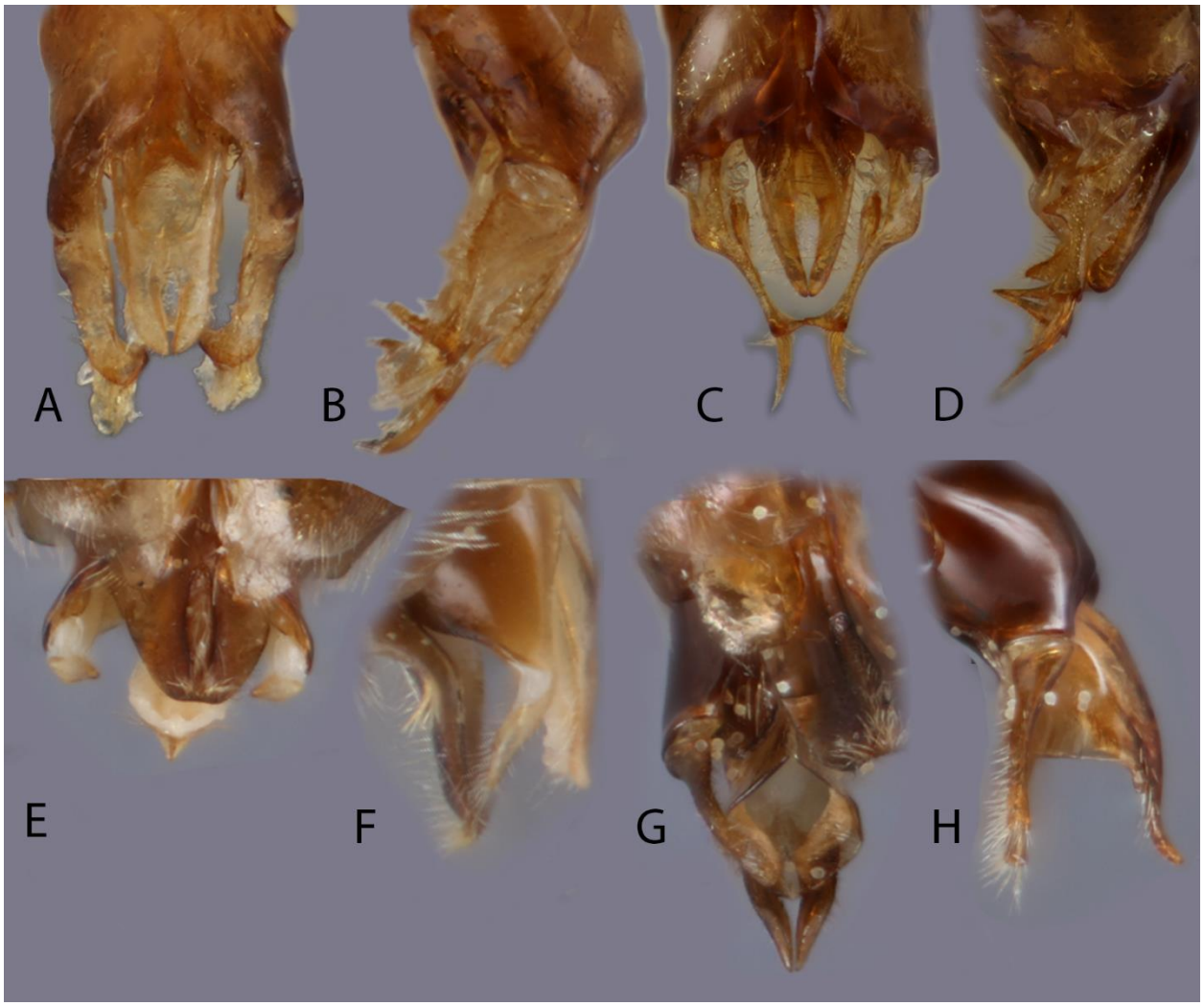


Figure 125. Genitalia of *Pterosarus* males. **A**. *Pr*. (*Pt*.) *alveus* dorsal. **B**. *Pr*. (*Pt*.) *alveus* lateral. **C**. *Pr*. (*Pt*.) *amor* dorsal. **D**. *Pr*. (*Pt*.) *amor* lateral. **E**. *Pr*. (*Pt*.) *andrenoides* ventral. **F**. *Pr*. (*Pt*.) *andrenoides* lateral. **G**. *Pr*. (*Pt*.) *atricornis* ventral **H**. *Pr*. (*Pt*.) *atricornis* lateral.

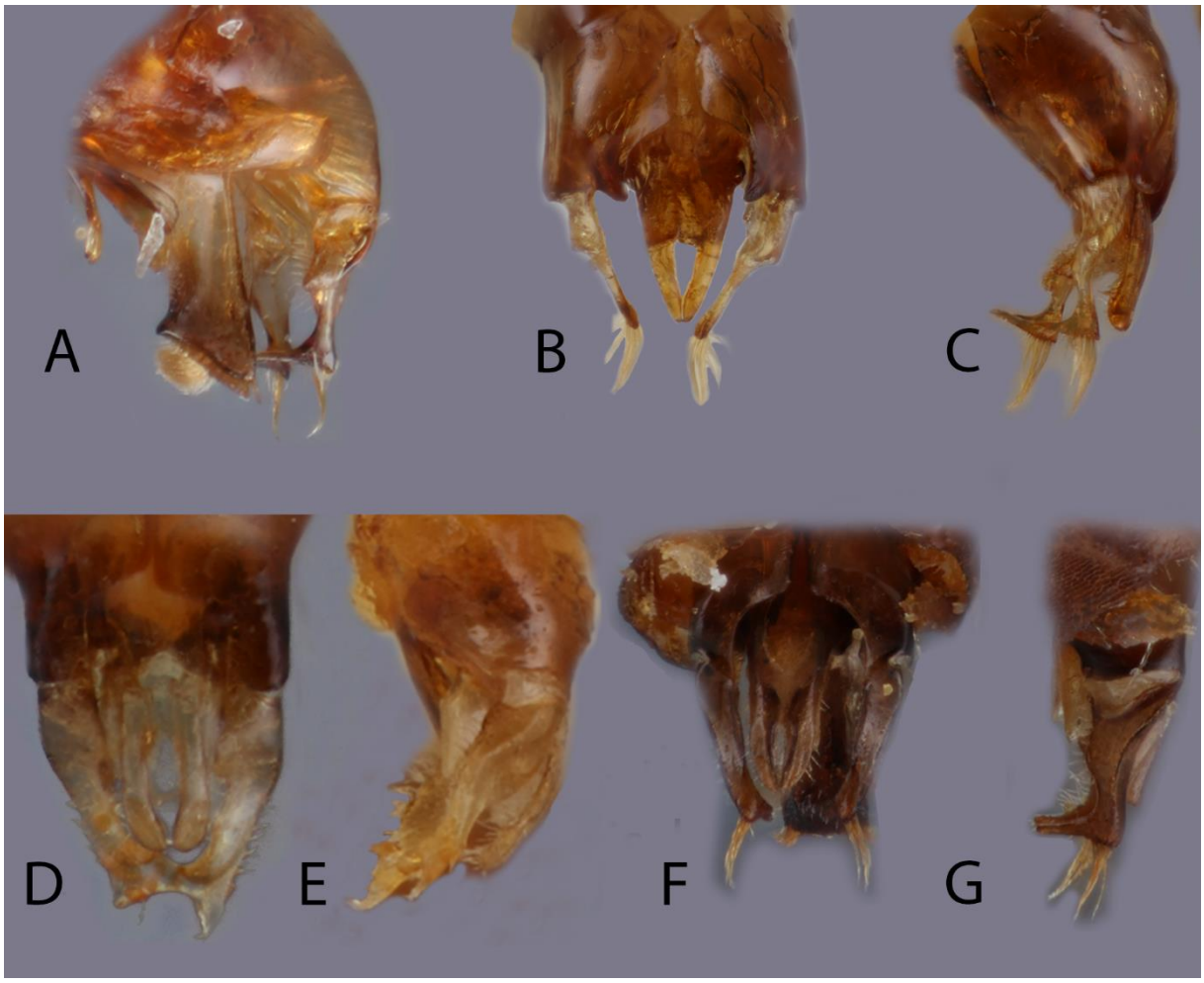


Figure 126. Genitalia of *Pterosarus* males. **A**. *Pr*. (*Pt*.) *barberi* lateral. **B**. *Pr*. (*Pt*.) *bidentis* dorsal. **C**. *Pr*. (*Pt*.) *bidentis* lateral. **D**. *Pr*. (*Pt*.) *bilobata* dorsal. **E**. *Pr*. (*Pt*.) *bilobata* lateral. **F**. *Pr*. (*Pt*.) *boylei* dorsal. **G**. *Pr*. (*Pt*.) *boylei* lateral.



Figure 127. Genitalia of *Pterosarus* males. **A**. *Pr*. (*Pt*.) *californica* lateral. **B**. *Pr*. (*Pt*.) *chepesepe* dorsal. **C**. *Pr*. (*Pt*.) *chepesepe* lateral. **D**. *Pr*. (*Pt*.) *citrinifrons* dorsal. **E**. *Pr*. (*Pt*.) *citrinifrons* lateral. **F**. *Pr*. (*Pt*.) *citripes* dorsal. **G**. *Pr*. (*Pt*.) *citripes* lateral **H**. *Pr*. (*Pt*.) *compositarum* lateral.

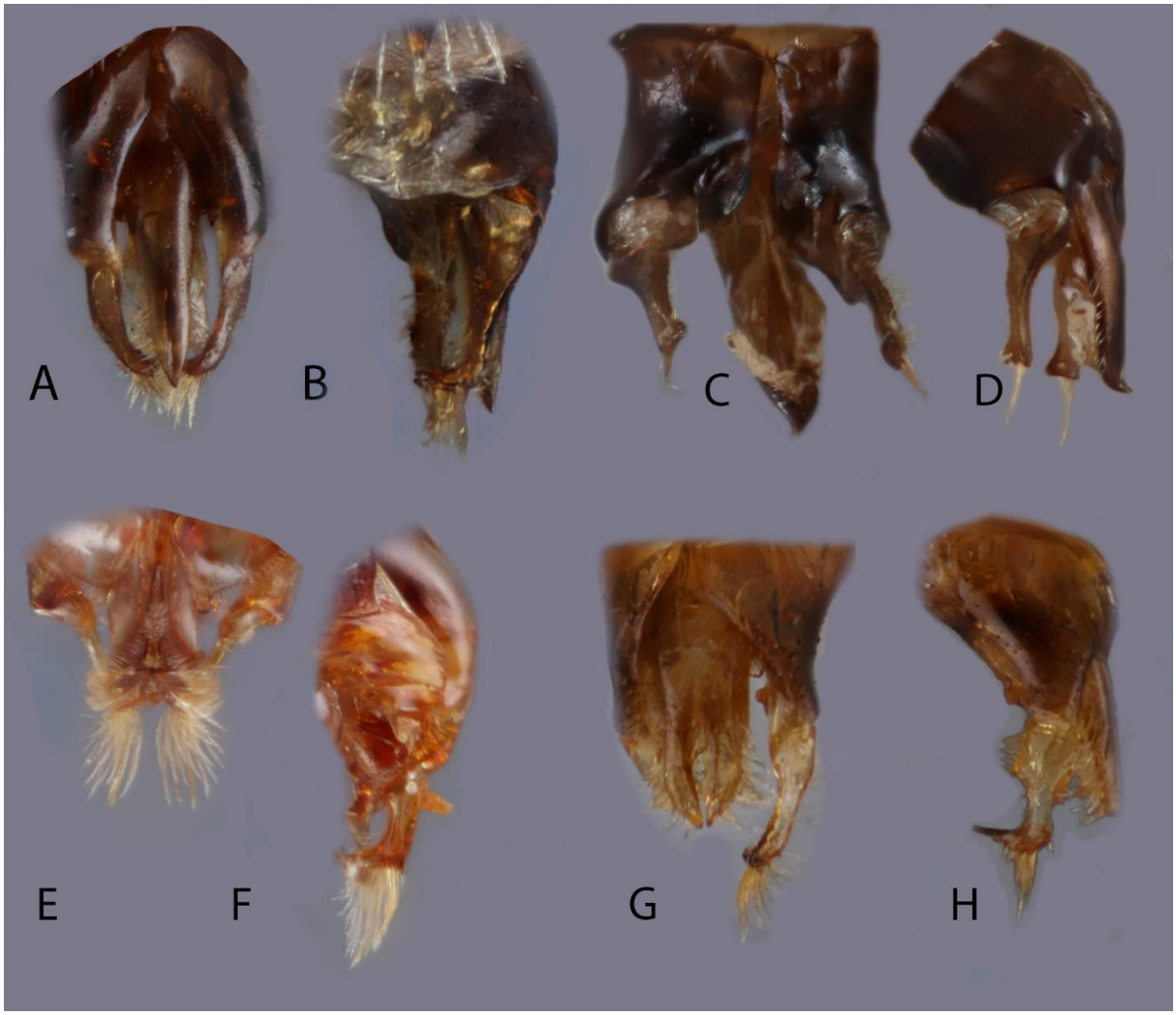


Figure 128. Genitalia of *Pterosarus* males. **A**. *Pr*. (*Pt*.) *didirupa* dorsal. **B**. *Pr*. (*Pt*.) *didirupa* lateral. **C**. *Pr*. (*Pt*.) *ehnesae* ventral. **D**. *Pr*. (*Pt*.) *ehnesae* lateral. **E**. *Pr*. (*Pt*.) *illustris* ventral. **F**. *Pr*. (*Pt*.) *illustris* lateral. **G**. *Pr*. (*Pt*.) *irregularis* dorsal **H**. *Pr*. (*Pt*.) *irregularis* lateral.

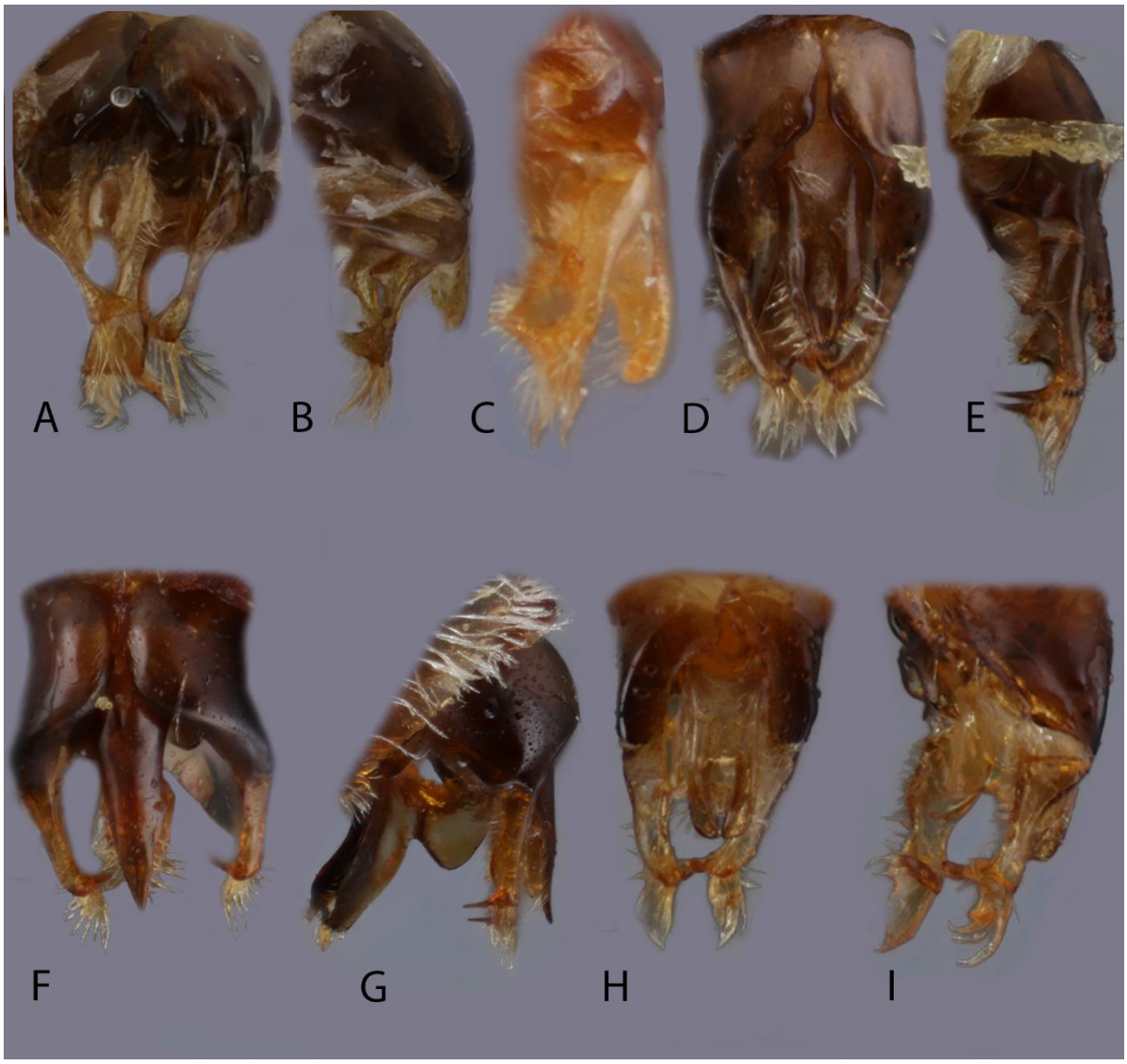


Figure 129. Genitalia of *Pterosarus* males. **A**. *Pr*. (*Pt*.) *labrosa* dorsal. **B**. *Pr*. (*Pt*.) *labrosa* lateral. **C**. *Pr*. (*Pt*.) *labrosiformis* lateral. **D**. *Pr*. (*Pt*.) *leucoptera* dorsal. **E**. *Pr*. (*Pt*.) *leucoptera* lateral. **F**. *Pr*. (*Pt*.) *luxsolaris* dorsal. **G**. *Pr*. (*Pt*.) *luxsolaris* lateral **H**. *Pr*. (*Pt*.) *nudescens* dorsal. **I**. *Pr*. (*Pt*.) *nudescens* lateral.



Figure 130. Genitalia of *Pterosarus* males. **A**. *Pr*. (*Pt*.) *occidua* dorsal. **B**. *Pr*. (*Pt*.) *occidua* lateral. **C**. *Pr*. (*Pt*.) *ornatipes* lateral. **D**. *Pr*. (*Pt*.) *occultata* lateral. **E**. *Pr*. (*Pt*.) *perlaevis* lateral. **F**. *Pr*. (*Pt*.) *piercei* lateral. **G**. *Pr*. (*Pt*.) *planafacialis* dorsal **H**. *Pr*. (*Pt*.) *planafacialis* lateral.



Figure 131. Genitalia of *Pterosarus* males. **A**. *Pr*. (*Pt*.) *prata* dorsal. **B**. *Pr*. (*Pt*.) *prata* lateral. **C**. *Pr*. (*Pt*.) *quadrapylae* dorsal. **D**. *Pr*. (*Pt*.) *quadrapylae* lateral. **E**. *Pr*. (*Pt*.) *renimaculata* lateral. **F**. *Pr*. (*Pt*.) *rowellae* dorsal. **G**. *Pr*. (*Pt*.) *rowellae* lateral **H**. *Pr*. (*Pt*.) *rudbeckiae* lateral.



Figure 132. Genitalia of *Pterosarus* males. **A**. *Pr*. (*Pt*.) *skeggox* dorsal. **B**. *Pr*. (*Pt*.) *skeggox* lateral. **C**. *Pr*. (*Pt*.) *solidaginis* lateral. **D**. *Pr*. (*Pt*.) *vicina* dorsal. **E**. *Pr*. (*Pt*.) **vicina** lateral. **F**. *Pr*. (*Pt*.) *vigvierae* dorsal. **G**. *Pr*. (*Pt*.) *vigvierae* lateral.

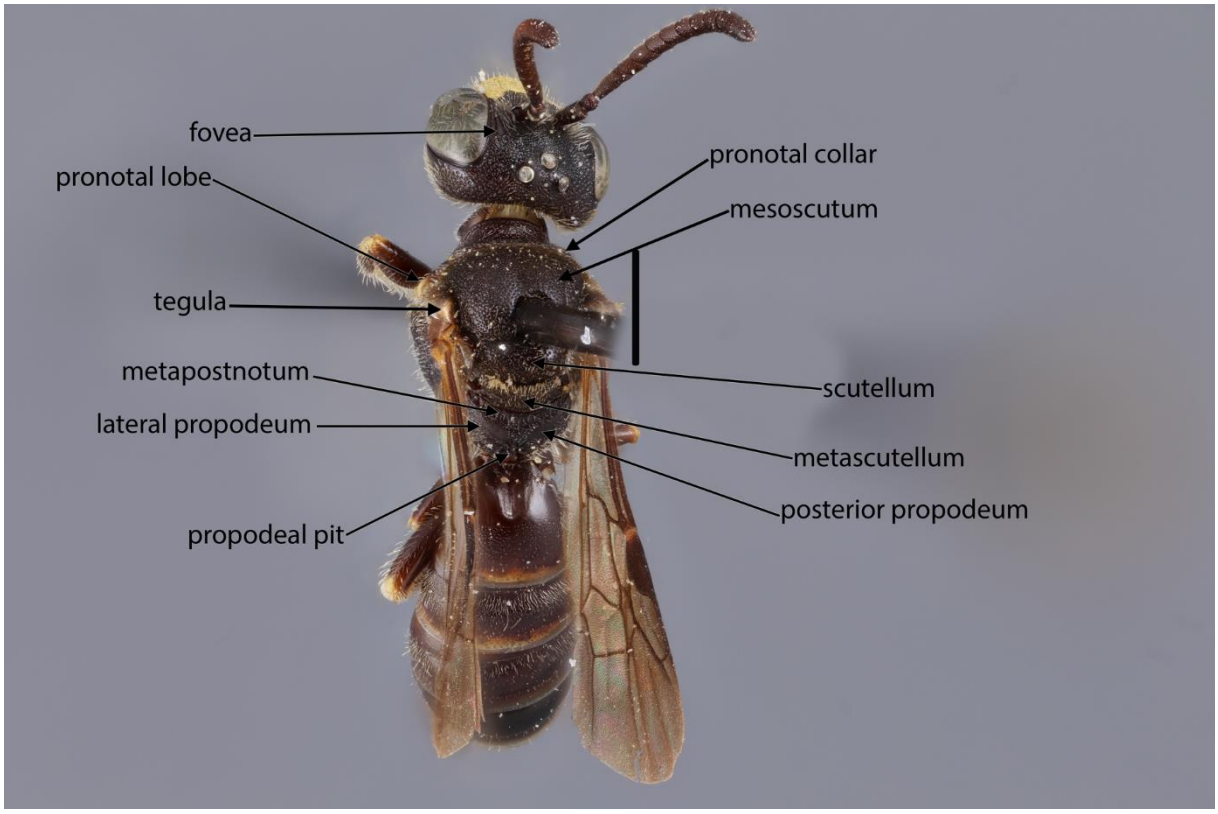


Figure 133. Glossary of dorsal structures. (*Protandrena andrenoides* ♂).

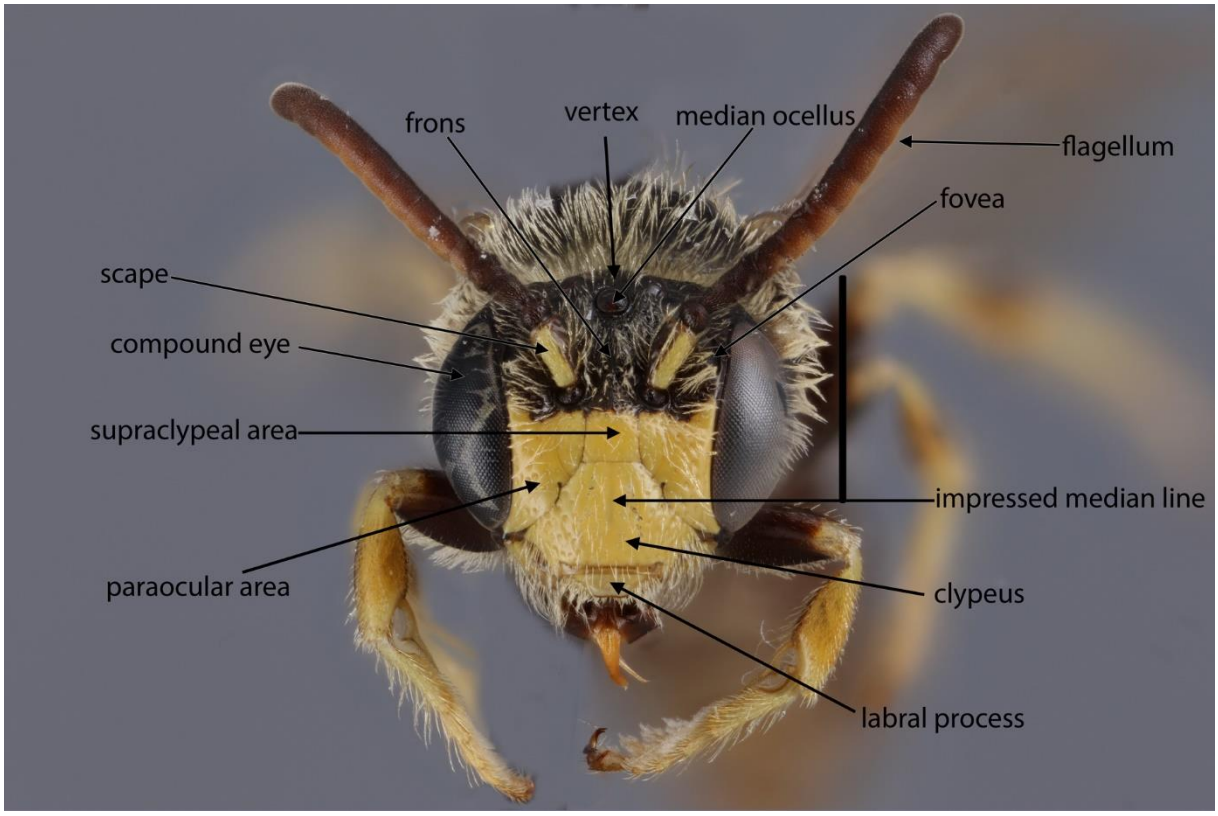


Figure 134. Glossary of head structures. (*Protandrena albertensis* ♂).

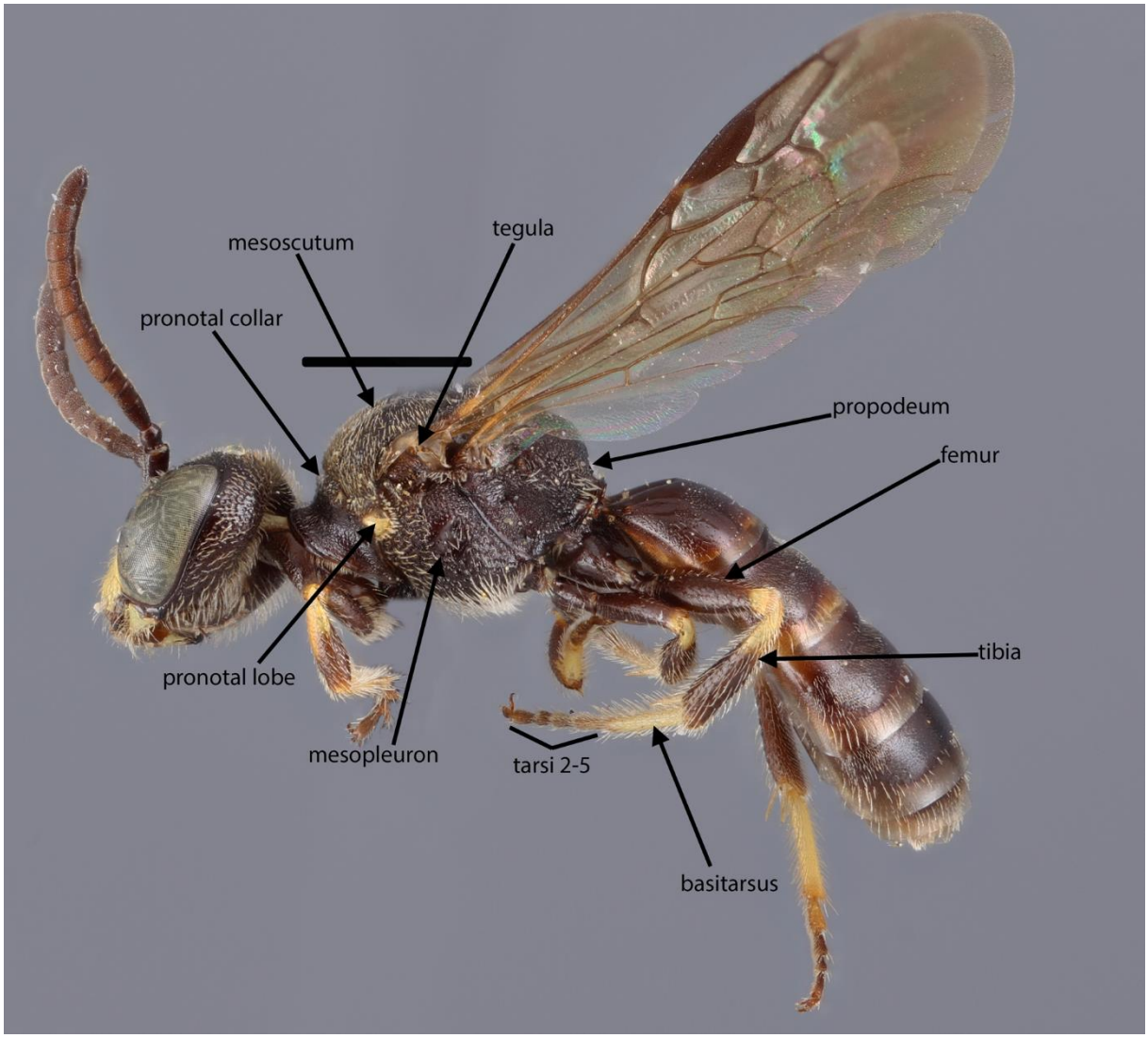


Figure 135. Glossary of lateral structures. (*Protandrena andrenoides* ♂).

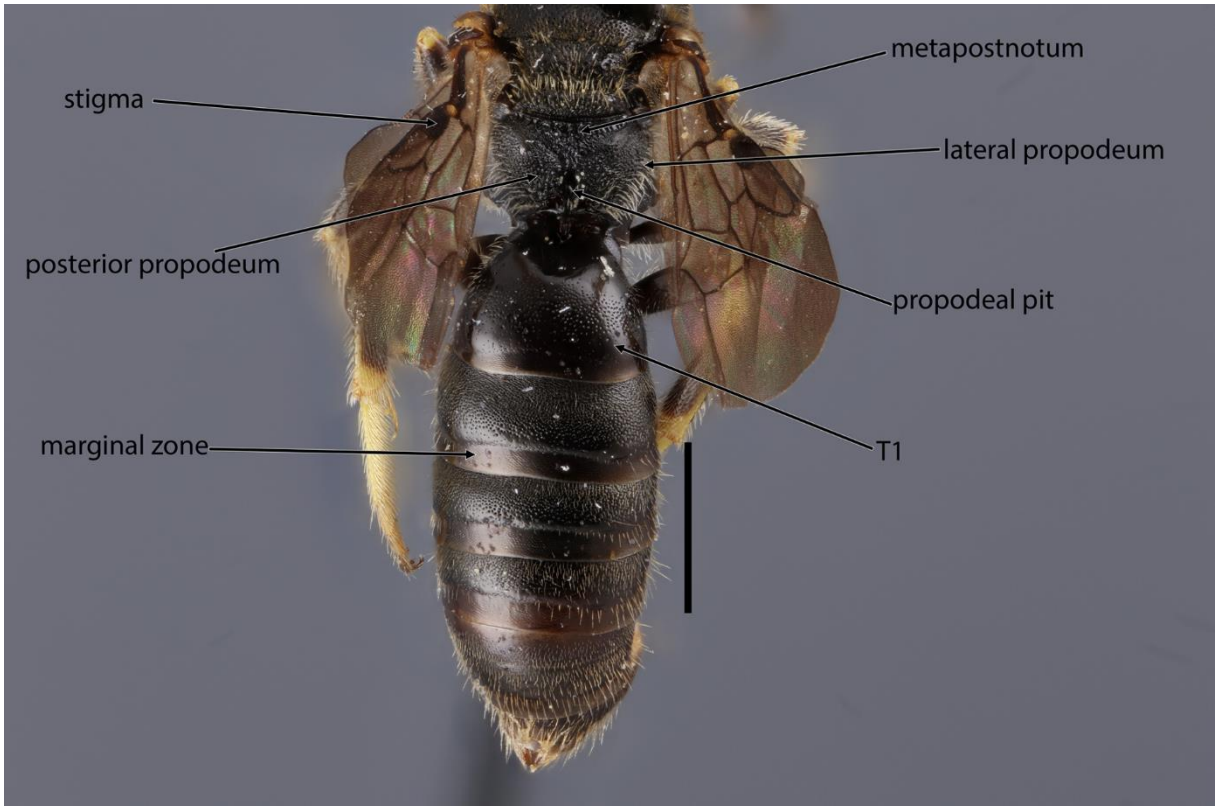


Figure 136. Glossary of posterior structures. (*Protandrena aestivalis* ♂)