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# Wool carder bees of the genus *Anthidium* in the Western Hemisphere (Hymenoptera: Megachilidae): diversity, host plant associations, phylogeny, and biogeography

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Bees are among the most important pollinators of flowering plants in most ecosystems. Recent concerns about population decline worldwide have highlighted the urgent societal need for species-level systematic work that facilitates assessments of the status of pollinators and pollination services. This is a comprehensive, broadly comparative study on the diversity, biology, biogeography, and evolution of *Anthidium* Fabricius, 1804, one of the most diverse megachilid genera, containing more than 160 species worldwide. Herein, the Western Hemisphere species are revised. All 92 recognized species, including the two adventive species *Anthidium oblongatum* (Illiger, 1806) and *Anthidium manicatum* (Linnaeus, 1758), are described and illustrated. A neotype for *Anthidium emarginatum* (Say, 1824) and lectotypes for 16 names are designated; five names are relegated to synonymy, three names are revalidated, previously unknown males of three species are described, and 21 new species are proposed. Identification keys as well as information on the distribution, seasonality, nesting biology, and host plants are provided. The relationships of the *Anthidium* subgenera and all Western Hemisphere species are explored using a cladistic analysis based on adult external morphological characters. The subgenus *Callanthidium* Cockerell, 1925, renders *Anthidium* s.s. paraphyletic in the analysis, and is here synonymized. The resulting phylogenetic hypothesis is used to examine possible biogeographical patterns, origins of the Western Hemisphere fauna, and the evolution of morphological traits associated with foraging for pollen from nototribic flowers and exudates from glandular trichomes. To facilitate the transfer of knowledge to non-specialists, some digital outputs and web-based products, including a geo-referenced specimen database consisting of more than 20 000 records, species pages, and interactive digital keys, were also developed during this study.

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**ADDITIONAL KEYWORDS:** Anthophila – Anthidiini – Apoidea – glandular trichomes – nototribic flowers – morphology – species hypotheses – systematics.

‘After working for many years I can see how a younger generation will do much better than we have been able to do. Yet I hope they will regard us with a certain measure of appreciation, for it was necessary to break the ground, if we could not always harvest the crop.’ (Cockerell, 1925c: 157)

‘Taxonomy has always been and shall remain essential for credible biology . . . Our generation is the first to fully appre-

ciate the threats facing millions of species, and the last generation with the opportunity to explore, describe and classify life on Earth so completely.’ (Wheeler, 2004: 571)

## INTRODUCTION

Most of the world’s biota remains unknown, despite more than 250 years of exploration, with millions of species waiting to be discovered, described, and classified. Because by naming and ordering life we make

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sense of the world around us, this challenge is not only the central problem of systematics but one of all humanity as well (e.g. Wilson, 1985; Wheeler, 2004; Yoon, 2009). There is still much we do not know about most organisms on earth, even about those, such as bees, that have received particular attention because of their ecological or economic role. Bees are the most important pollinators of flowering plants in most ecosystems (Grimaldi & Engel, 2005; Michener, 2007), and recent concerns about population declines have increasingly highlighted the need for a better taxonomic understanding and more accessible information on native bees to assess the status of pollinators and pollination services (e.g. Biesmeijer *et al.*, 2006; Potts *et al.*, 2010). However, even in areas where bee faunas have been intensively studied, such as North America, biological information is limited to a few common bees, some species are known from a single sex, many are waiting to be described, and traditional identification keys are often outdated or non-existent. Without a doubt, this taxonomic impediment delays timely assessments of bee population trends and the conservation of native pollinators.

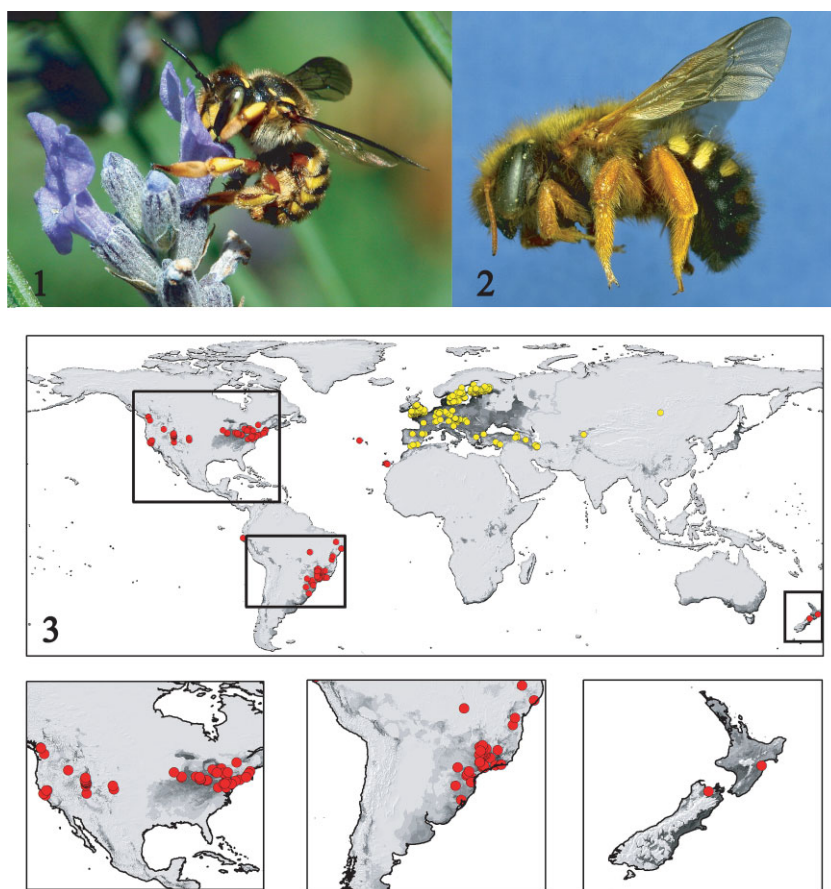
Species concepts are hypotheses that are subject to rigorous tests when other species, specimens, or characters are discovered (Wheeler, 2004, 2008). As in many groups of organisms, the taxonomic status of the vast majority of bees have not been tested since they were proposed by earlier scientists based upon unspecified or nonexistent concepts of species, limited knowledge of their biology and distribution, and, at most, a vague idea of their morphology given the equipment available at the time (only hand lenses or rustic microscopes). Thus, we have entered the 21st century with old, untested hypotheses that remain to be tested by yet-to-be recognized characters useful in species recognition, and explored via phylogenetic studies.

Megachilidae is a bee family containing more than 4000 described species in 76 genera worldwide (Michener, 2007; Ascher & Pickering, 2012), a diversity that appears promoted by the innovation of the use of foreign materials in nest building (Litman *et al.*, 2011). Recently, Gonzalez *et al.* (2012) revised the higher-level phylogeny and classification of the family based on adult morphology of extinct and extant taxa, and recognized nine tribes and four subfamilies. Megachilids include many pollinators of natural, urban, and agricultural environments, and they are often among the most common native bees in a given ecosystem. For example, *Megachile rotundata* (Fabricius, 1787) has been introduced to many parts of the world as a pollinator of alfalfa (Michener, 2007; Pitts-Singer & Cane, 2011). Megachilid bees are also notable as the most common invasive bees, including multiple species in the genus *Anthidium*

(Jaycox, 1967a; Hoebeke & Wheeler, 1999; Cane, 2003; Gonzalez, Koch & Griswold, 2010; Figs 1–3). For instance, *Anthidium manicatum* (Linnaeus, 1758) is perhaps the most widely distributed unmanaged bee species in the world. It was unintentionally introduced to North America in the late 1960s from Europe, and is now established transcontinentally, as well as in South America, the Mediterranean region, New Zealand, and the Canary Islands (Jaycox, 1967a; Gibbs & Sheffield, 2009; Strange *et al.*, 2011). The impact of this bee on native pollinators needs to be studied.

*Anthidium* Fabricius, 1804, is among the most diverse genera of Megachilidae, containing more than 160 species worldwide (Ascher & Pickering, 2012). *Anthidium* are solitary bees that usually nest in pre-existing cavities in soil, walls, wood, and stems, and are commonly known as wool-carder bees because their cotton-like brood cells are made of plant hairs or trichomes (Grigarick & Stange, 1968; Müller, Töpfl & Amiet, 1996; Michener, 2007). Such carding behaviour is only known from a small number of genera within the tribe Anthidiini, and is likely to be associated with certain structural features in the female, such as multidentate mandibles that facilitate the gathering and manipulation of plant material. Another distinctive feature, the presence of a dense tomentum on the outer surface of basitarsi, helps to absorb extrafloral trichome secretions that are then added to the plant hairs used for cell construction; such secretions, in addition to facilitating trichome manipulation, may also waterproof the cell and prevent microbial attacks (Müller *et al.*, 1996). Although floral relationships are largely unknown in *Anthidium*, the scant information suggests that some species may specialize on several plant families for pollen. Females of some species in both the New World (NW) and the Old World (OW) have hooked, curved, or wavy hairs on the face, related to pollen-collecting behaviour from nototribic flowers (bilateral flowers in which filaments and styles are located on the adaxial side or on the top of the flower) of the families Lamiaceae, Fabaceae, and Plantaginaceae. In some OW species, corkscrew-like hairs on the ventral surface of the mesosoma are used to collect pollen from inflorescences of some Asteraceae (Müller, 1996a, b). Examples of modified hairs on other parts of the body are known, but corresponding floral records and behavioural studies are still lacking.

Following the classificatory proposal of Michener (2007), seven subgenera of *Anthidium* are currently recognized: *Anthidium s.s.*, *Callanthidium* Cockerell, 1925, *Gulanthidium* Pasteels, 1969, *Nivanthidium* Pasteels, 1969, *Proanthidium* Friese, 1898, *Severanthidium* Pasteels, 1969, and *Turkanthidium* Pasteels, 1969. Nearly all species in the NW belong to the



**Figures 1–3.** Wool carder bees of the genus *Anthidium*: 1, female of *Anthidium manicatum* on lavender flowers (*Lavandula* sp.) in Logan, UT, USA (photograph by Jim Cane); this Old World species is invasive to North America and other regions of the world; 2, female of *Anthidium rubripes* in lateral view; 3, global distribution map of *A. manicatum* – yellow and red circles represent occurrences in the native and invasive ranges.

widespread nominate subgenus, except for the two species placed in *Callanthidium* and *Anthidium oblongatum* (Illiger, 1806), a species of the OW subgenus *Proanthidium* established in the upper midwest and north-eastern North America (Hoebeke & Wheeler, 1999; Miller *et al.*, 2002). *Anthidium* species in the NW are more usually found in xeric climates of temperate areas than in tropical forests; in North America most species occur in the western USA, whereas in South America many occur at mid or high elevations in the Andes. Regional revisions, Grigarick & Stange (1968) for California and Urban (2002, 2004) for South America, exist, but no comprehensive study of the NW *Anthidium* has been attempted. Undoubtedly, this hinders our interpretations on the diversity and evolution of these bees. Herein, we revise all species in the NW and provide the traditional taxonomic elements of keys, descriptions, illustrations, and comparative statements for all 92 recognized species, including 21 new species described here. Results of this revision suggest a

nearly equal representation between the two NW continents: 42 species occur in North America (including Central America) and 51 species occur in South America. Except for the adventive *A. manicatum*, no species is known to occur in both continents of the Western Hemisphere. We explore the phylogenetic relationships among *Anthidium* subgenera and NW species using a cladistic analysis of adult morphological external characters. We also use the resulting phylogenetic hypothesis to examine possible biogeographical patterns, origins of the NW fauna, and the evolution of morphological traits associated with foraging for pollen from nototribic flowers and exudates from glandular trichomes.

In addition to the traditional elements of systematics presented here, we are generating the following digital outputs: (i) specimen data captured from all examined specimens (> 20 000 specimens) and georeferenced in a relational database served through the Global Biodiversity Information Facility (GBIF); (ii) fully illustrated species pages that include



distribution maps, information on host plants, and seasonality generated from museum databases; and (iii) an interactive digital identification guide that will assist conservation biologists, pollination providers, and bee researchers to reliably identify these bees. These guides are open-access, use less technical vocabulary than traditional keys, allow users to select more than one character from a wide range of diagnostic characters, and include all known intraspecific variations for each character. An additional advantage is the ability to update these guides whenever new species or new variations are found. The species pages and identification guides are being developed in Discover Life (<http://www.discoverlife.org>), in collaboration with Sam Droege and Kimberly Huntzinger, and in a community-maintained portal on bees (<http://apoidea.lifedesks.org/>) served through the Encyclopedia of Life (<http://www.eol.org/>).

We hope that by integrating these information and digital technologies, the results of this work will significantly contribute to the urgent societal need for species-level systematic work on bees, making the information more meaningful to biologists and accessible to society.

## MATERIAL AND METHODS

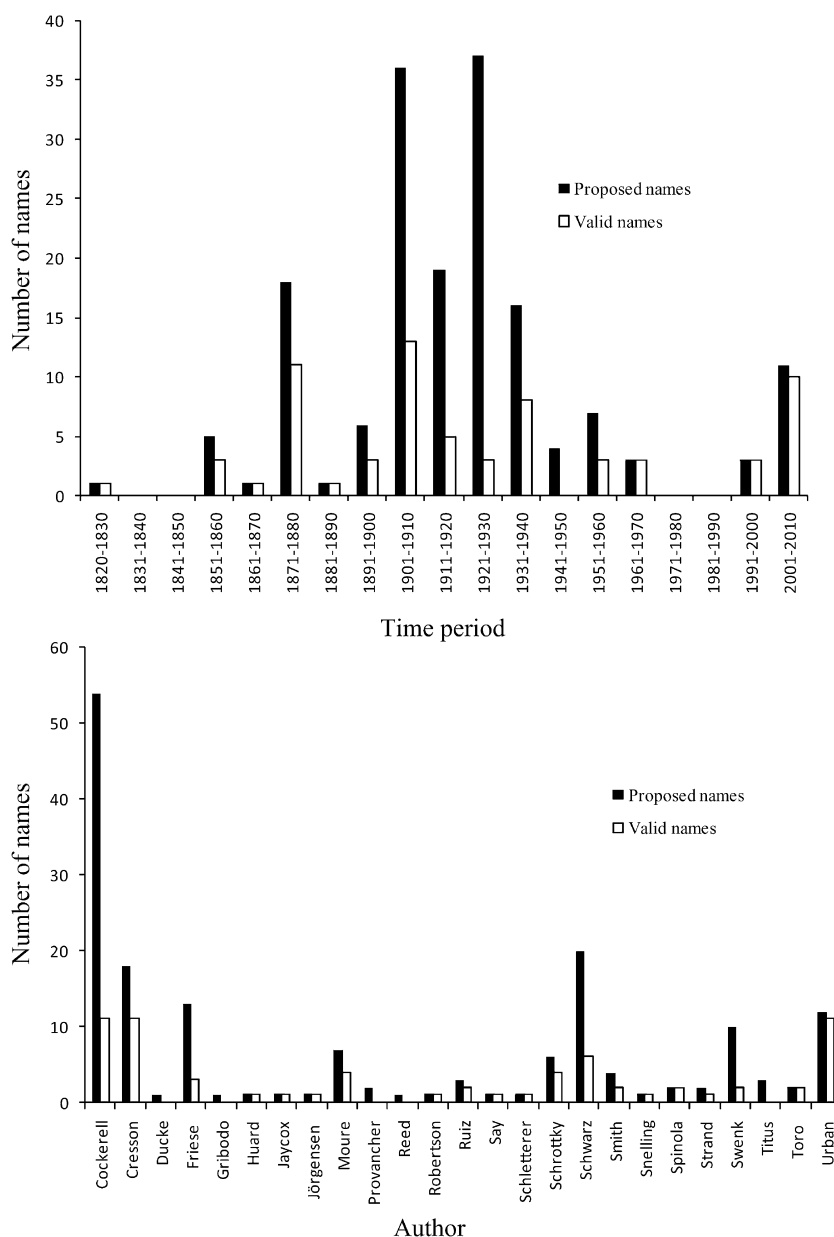
### PRIMARY TYPES AND SPECIES ACCOUNTS

A total of 168 species names associated with the NW species of *Anthidium*, as currently defined (Michener, 2007), have been proposed since 1824 by a total of 25 authors; five of these names were preoccupied. A large percentage of the total number of names (64%) were proposed during the first four decades of the 1900s, most of them by T.D.A. Cockerell (54 names) and H.F. Schwarz (20). Although Cockerell described the greatest number of *Anthidium* species (32.1% of the total), only 11 of them are currently considered valid species (Fig. 4). We attempted to examine the primary types or type series for all 168 species names. We were unable to study types of 14 species: *Anthidium adriani* Ruiz, 1935, *Anthidium andinum* Jörgensen, 1912, *Anthidium aterrimum* Friese, 1925, *Anthidium clypeodentatum* var. *lutzi* Schwarz, 1928, *Anthidium codoense* Ducke, 1907, *Anthidium compactum* Provancher, 1896, *Anthidium espinosai* Ruiz, 1938, *Anthidium flavomaculatum* Friese, 1908, *Anthidium gayi* Spinola, 1851, *Anthidium pondreum* Titus, 1902, *Anthidium spinolae* Gribodo, 1894, *Anthidium 3-cuspidum* Provancher, 1896, *Dianthidium balli* Titus, 1902, and *Megachile emarginata* Say, 1824 [= *A. emarginatum* (Say, 1824)]. Some of the types or syntypes associated with these names have long been known to be destroyed, such as that of *M. emarginata*, others are missing (e.g. *A. aterrimum*), or could not

be examined (e.g. *A. codoense*). Further comments regarding these species names are found under the comments section of the species accounts. The type of *Anthidium albitarse* Friese, 1917, was found to be conspecific with one of the two species of *Hypanthidioides* subgenus *Michanthidium* Urban, 1995, and is treated in Gonzalez & Griswold (2011). For each species, only significant taxonomic changes (e.g. synonymies, change of status, etc.) are referenced because a complete list of citations for all *Anthidium* species of the Western Hemisphere can be found in the catalogues of Hurd (1979) and Urban & Moure (2007), and are not duplicated here.

### LECTOTYPE DESIGNATION

Several *Anthidium* species are based on syntype series. To stabilize names, we made an effort to locate the syntypes and designate lectotypes. Before designating the lectotype, we compared the available specimen(s) and label data with the original description to ensure their validity as syntypes, then selected the specimen in best condition or, when a choice was available, the most easily identifiable sex. Often older authors, namely Cockerell and H. Friese, did not state the number of specimens upon which they based a description. Cockerell usually labelled one specimen as 'type', and the others in the type series as 'cotype', corresponding to the holotype and paratype concepts in the current terminology (C.D. Michener, pers. comm. 2009), in which case we accepted the 'type' as the holotype. However, it seems that in his earlier works around the 1900s he used a 'type' label for all specimens, and in those cases we have designated one of them as a lectotype. As discussed by Rasmussen & Ascher (2008), the works of Friese present special problems for type recognition for the following reasons: first, unless he explicitly stated in the publication that only a single specimen was available to him, he could have had any number of specimens, thus resulting in syntype series. Second, some Friese types have a red or orange 'type' label, which he often added to material he later received and identified as conspecific with previously described taxa. Although it seems that the red labelled 'type' specimens were intended by Friese as primary types, he was not consistent in this practice. Third, he sold or donated many of his specimens to several museums in Europe and North America, often including 'types' of unpublished manuscript names. Thus, unless explicitly stated in the publication as the type, or evidence for a single specimen is presented in the original description, we regarded as syntypes even apparently unique Friese types in collections, as suggested by Rasmussen & Ascher (2008).



**Figure 4.** Histograms showing the number of proposed species names and currently considered valid species of New World *Anthidium* per decade (top figure) and author (bottom). A total of 168 species names have been proposed between 1824 and 2004, including five preoccupied names. In this revision, 69 of those names are considered valid species (excluding the two adventive species *Anthidium oblongatum* and *Anthidium manicatum*).

#### SPECIMEN DATABASE AND REPOSITORY COLLECTIONS

The label information from all examined specimens of *Anthidium* (> 20 000 specimens) was captured and their localities georeferenced using Google Earth™ (<http://earth.google.com/>). Such information was then added to the National Pollinating Insect Database (NPID), housed at the Agricultural Research Service Pollinating Insect Research Unit (PIRU) in Logan,

Utah, USA, and can be found through the Global Biodiversity Information Facility (GBIF): <http://ipt.pensoft.net/ipr/resource.do?r=anthidium>. For practical reasons complete label data for the examined material are only given for the new species described herein, but are represented for all North American and many South American species in the maps. All data will be presented in a separate companion data publication.

We examined or borrowed material from the following institutions and individuals, except for those indicated with an asterisk, which house types we were unable to examine. The names of the people who kindly arranged these loans are indicated in parentheses: AMNH, American Museum of Natural History, New York, USA (J. Ascher, H. Campbell, C. LeBeau, J. Rozen); ANSP, Academy of Natural Sciences, Philadelphia, Pennsylvania, USA (D. Otte, J. Weintraub); BBSL, USDA-ARS Bee Biology and Systematic Laboratory, Logan, Utah, USA; BNHM, British Natural History Museum, London, UK (D. Notton); BYUC, Monte L. Bean Life Science Museum, Arthropod Collection, Provo, Utah, USA (S. Clark); CAS, California Academy of Sciences, San Francisco, California, USA (V. Lee, W. Pulawski); CEET, Colección de Insectos Asociados a Plantas Cultivadas en la Frontera Sur, El Colegio de la Frontera Sur, Tapachula, Chiapas, Mexico; CNC\*, Canadian National Collection of Insects, Arachnids, and Nematodes, Ottawa, Ontario, Canada; CSPN\*, Colegio San Pedro Nolasco, Santiago, Chile; CTMI, Central Texas Melittological Institute, Austin, Texas, USA (J. Neff); CUIC, Cornell University Insect Collection, Ithaca, New York, USA (B. Danforth); DZUP, Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, Brazil (D. Urban, G. Melo); EBCC, Estación de Biología Chamela, Universidad Nacional Autónoma de México, San Patricio, Jalisco, Mexico (R. Ayala); EMEC, Essig Museum of Entomology, University of California, Berkeley, California, USA (C. Barr, R.L. Zuparko); FSCA, Florida State Collection of Arthropods, Florida State University, Gainesville, Florida, USA (L. Stange, J. Wiley); GAM, University of Georgia Museum of Natural History, Athens, Georgia, USA (R. Hoebeke); INHS, Illinois Natural History Survey, Urbana, Illinois, USA (P. Tinerella); LACM, Natural History Museum of Los Angeles County, Los Angeles, California, USA (B. Brown); LS\*, The Linnean Society of London, UK; MACN, Museo Argentino de Ciencias Naturales 'Bernardino Rivadavia', Buenos Aires, Argentina (A. Roig Alsina); MDC, Missouri Department of Conservation, St. Charles, Missouri, USA (M. Arduser); MEUC, Colección del Museo Entomológico Luis Peña, Departamento de Sanidad Vegetal, Universidad de Chile, Santiago, Chile; MEFLG, Museo Entomológico Francisco Luis Gallego, Universidad Nacional de Colombia, Medellín, Colombia (A. Smith-Pardo); MLP\*, Museo de la Plata, La Plata, Argentina; MNHN\*, Museo Nacional de Historia Natural, Santiago, Chile; MNRJ\*, Museu Nacional, Universidade Federal do Rio de Janeiro, Quinta da Boa Vista, Rio de Janeiro, Brazil; NHMW, Naturhistorisches Museum Wien, Wien, Austria (D. Zimmermann); MPQ\*, Musée du Parlement, Québec, Canada; MPEG\*, Museu Paraense Emílio Goeldi, Belém, Brazil; MSNT, Museo Regionale

di Scienze Naturali, Torino, Italy (G. Pagliano); MZUSP, Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil; SDNHM, San Diego Natural History Museum, San Diego, California, USA (P. Horsley, M. Wall); SEMC, Snow Entomological Museum, University of Kansas, Lawrence, Kansas, USA (M.S. Engel, Z. Falin, C.D. Michener, J. Thomas); OJSM, Orma J. Smith Museum of Natural History, The College of Idaho, Caldwell, Idaho, USA (W.H. Clark); OSAC, Oregon State Arthropod Collection, Oregon State University, Corvallis, Oregon, USA (C. Marshall); PCYU, Packer Collection at York University, Toronto, Ontario, Canada (L. Packer); PERC\*, Purdue Entomological Research Collections, Purdue University, West Lafayette, Indiana, USA; RAM, Royal Alberta Museum, Edmonton, Alberta, Canada (M. Buck); TAMU, Texas A&M University Insect Collection, College Station, Texas, USA (E. Riley); UAIC, University of Arizona Insect Collection, Tucson, Arizona, USA (C. Olson); UAAM, University of Arkansas Arthropod Museum, Fayetteville, Arkansas, USA (J. Barnes); UCF, University of Central Florida Collection of Arthropods, Department of Biology, Orlando, Florida, USA (S. Fullerton); UCM, University of Colorado Museum of Natural History, Boulder, Colorado, USA (D. Bowers, V. Scott); UCDC, University of California, Bohart Museum of Entomology, Davis, California, USA (L. Kimsey, R. Thorp); UCR, University of California, Riverside, California, USA (D. Yanega); UNAB, Museo Entomológico, Departamento de Agronomía, Universidad Nacional de Colombia, Bogotá, Colombia (F. Serna, E. Vergara); UNAM, Museo de Zoología Alfonso L. Herrera, Facultad de Ciencias, Universidad Nacional Autónoma de México, Mexico (M.A. Luís-Martínez, O. Yañez); UNSM, University of Nebraska State Museum, Lincoln, Nebraska, USA (M.J. Paulsen, B. Ratcliffe); USNM, National Museum of Natural History, Washington, DC, USA (B. Harris, S. Brady); ZMB, Museum für Naturkunde, Humboldt-Universität zu Berlin, Berlin, Germany (F. Koch, V. Ritcher).

#### MORPHOLOGY AND TAXONOMIC DESCRIPTIONS

Morphological terminology follows that of Michener (2007). The abbreviations F, OD, PW, S, and T, are used for antennal flagellomere, ocellar diameter, one puncture width, and metasomal sternum and tergum, respectively. Measurements were rounded to the nearest tenth of a millimetre, and were taken using an ocular micrometer on a Leica MZ12 stereomicroscope. Total body length was estimated by measuring the combined lengths of the head, mesosoma (from the clypeus to the propodeum, in profile), and metasoma, and adding the values. Forewing length was measured from the posterior border of the tegula to

the tip of the forewing. Photomicrographs were taken using a Keyence® VHX-500F Digital Imaging System.

Species descriptions emphasize structural characters, such as punctuation of terga, clypeal margin of the female, and genitalia and hidden sterna of the male. Because these structures are complex, female T6 and male T7, S4, S6–S8 are illustrated for all species possible (species only known from the type were not dissected). A sample of genitalic styles is also provided. Such characters have proven to be more reliable in species recognition than body colour, which has been relied on by many authors because of the conspicuous yellow or cream maculations of both sexes of *Anthidium*. The following areas are commonly coloured in *Anthidium*: outer surface of mandible (except distal margin), clypeus, paraocular area, vertex, pronotal lobe, anterolateral and lateral margins of scutum, tegula, axilla, distal margin of scutellum, inferior margins of femora, outer surfaces of tibiae and basitarsi, and discs of terga. Although colour pattern might prove useful in the recognition of some species or species groups (e.g. in some species from South America the wing bases, legs, tegula, and antenna are ferruginous, contrasting with the remaining black areas of the body), it is usually highly variable, even among specimens from the same locality. Therefore, colour is described and qualitatively evaluated to give an idea of its variation among the examined material, but is not the basis for taxonomic decisions.

The following paragraphs are intended to introduce the characters used in the descriptions and key to species.

In the female, the punctuation, pubescence, and shape of the clypeus vary across species. It is usually gently convex, with the integument smooth and shiny between coarse, nearly contiguous punctures, as on remaining areas of the face; it is often sparsely covered with semi-erect, branched hairs. However, in a few species (e.g. *Anthidium maculosum* Cresson, 1878), the clypeus is distinctly flat, as on supraclypeal area and frons, sparsely punctate, and covered with erect, stiff, apically curly or hooked hairs (Fig. 5E). The shape of the clypeal margin is also an important character for separating species. It is usually thin, with one or two sublateral projections or teeth (Fig. 6); the median portion, between the sublateral teeth, is usually straight, but in some species is distinctly emarginate or strongly tuberculate.

The mandible has five or more teeth, separated by acute notches (Figs 7–10); the number of teeth is variable within species, sometimes even in the same specimen; however, the shape or length of the first or apical tooth (numbered from ventral to dorsal) is distinctive in some species such as in *Anthidium sonorensis* Cockerell, 1923 (Fig. 10). In most species it is longer and broader than the remaining teeth. The

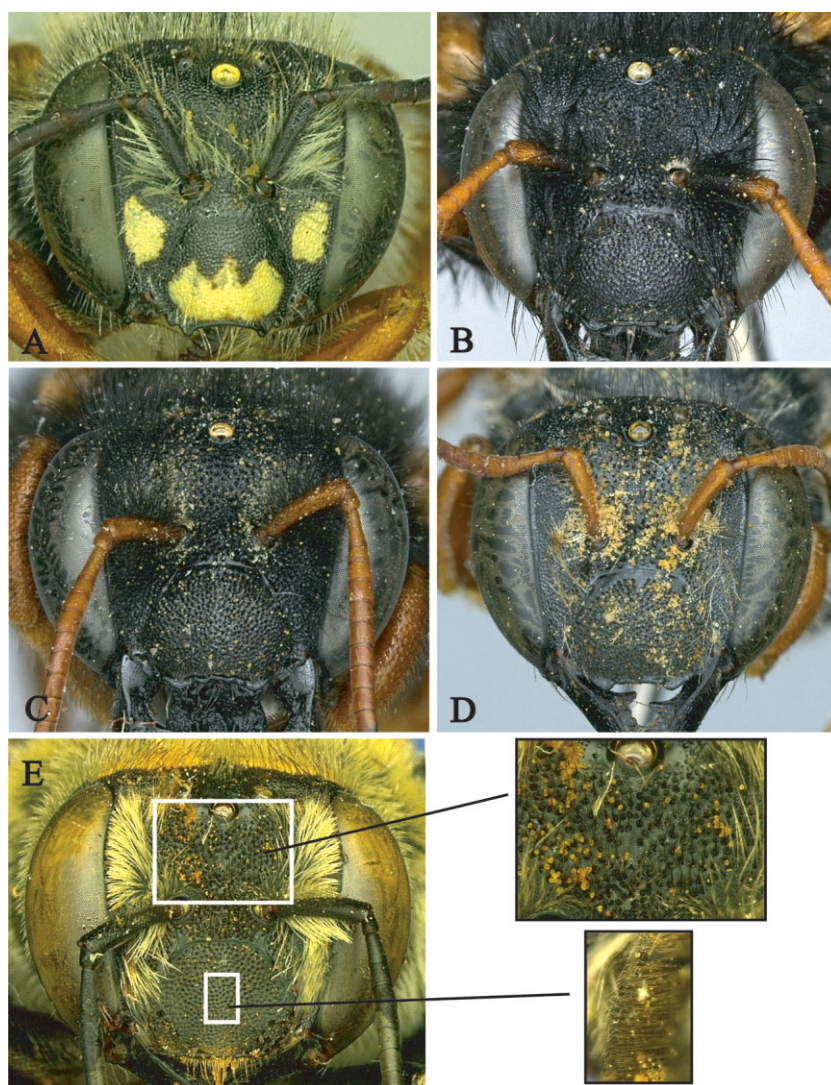
acetabular interspace is usually clearly flattened or depressed, such that the outer surface of the mandible has a distinguishable basal, lateral surface, and a distal, anterior surface; the outer ridge is long, reaching the teeth (e.g. Fig. 8). In some species, such as *Anthidium paroselae* Cockerell, 1898, and *A. sonorensis*, the acetabular interspace is not conspicuously flattened or depressed, gently curving towards the base of the mandible, and the outer ridge is short, ending well before reaching the teeth (Figs 9, 10).

The labrum is rectangular, with a median longitudinal depression or fossa (Figs 11–13). It is usually unmodified basally, but in some species there are a pair of distinct tubercles (basal protuberances or projections) easily visible even when the mandibles are closed (Fig. 11). Another pair of projections or horns (preapical projections hereafter) is sometimes present near the middle or at the apical one-third of the labrum (Figs 12, 13).

For the antenna, the pubescence of the scape and the length of F1 distinguish some species. The anterior surface of the scape is usually sparsely covered by long hairs, whereas the posterior surface is covered with minute hairs or is nearly hairless. However, in *A. clypeodentatum* and *A. psoraleae* the posterior surface is distinctly covered by a short, white tomentum (Fig. 14); the function of such pubescence is unknown. F1 is usually shorter than the combined lengths of F2 and F3, but in a few species it is elongate, at least as long as the combined lengths of F2 and F3 (Fig. 15).

On the mesosoma, the punctuation of the scutum and scutellum (Figs 16, 17), presence or absence of a longitudinal carina (Fig. 18) on the outer surface of the hind tibia (tibial carina hereafter), and the pubescence of the outer surfaces of basitarsi are also variable among species (Figs 19–21). The tibial carina is usually distinct in both sexes, but it is difficult to see in some species with yellow integument (e.g. *A. paroselae*); such species appear twice in the key to species. The outer surface of the basitarsi of all legs is often densely covered by white tomentum (among long erect hairs), sometimes obscuring the integument and giving the impression of a more robust basitarsus (Fig. 19); in some species it is absent on the hind basitarsus or is only present on the fore basitarsus (e.g. *Anthidium edwini* Ruiz, 1935). The tomentum on the outer surface of the basitarsi is absent in the male. In *Anthidium palliventris* Cresson, 1878, and to some extent in *Anthidium rodecki* Schwarz, 1934, the posterior margin of the fore basitarsus is fringed with long, simple hairs (Fig. 21); both species are only found on sand dunes and, at least in the former species, such hairs are used to excavate their own nests (Hicks, 1928). Wings are usually brownish, darker on the anterior half of the marginal cell, and sometimes on

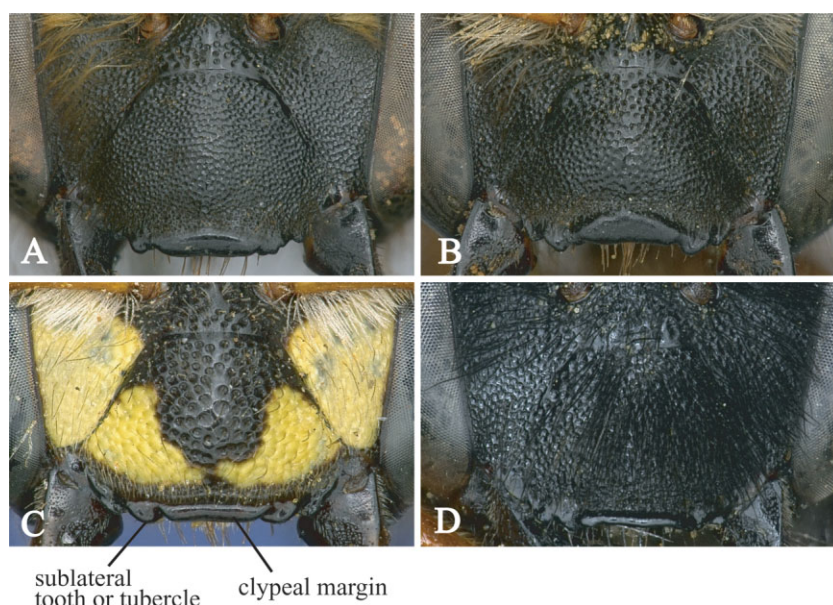




**Figure 5.** Unmodified (A) and modified faces (B–E) of *Anthidium* females for collecting pollen from nototribic flowers: A, *Anthidium adelphum* sp. nov.; B, *Anthidium kolla* sp. nov.; C, *Anthidium cafayate* sp. nov.; D, *Anthidium calchaqui* sp. nov.; E, *Anthidium rodriguezi*, with details of the integument and apically wavy or curved hairs.

the apex of the radial cell; stigma and veins are usually dark brown; however, in some species (e.g. *A. paroselae*), wings are nearly transparent, with little or no brownish stains at all, whereas in *Anthidium rodriguezi* Cockerell, 1912, they are distinctly dark, and sometimes with weak blue and violet reflections as on *Anthidium weyrauchi* Schwarz, 1943. In several South American species, wing bases are ferruginous on legs, tegula, and antenna. The propodeal triangle (= metapostnotum) is usually finely and densely punctate on its basal half (dorsal portion); the impunctate distal half (ventral portion) is usually dull, finely imbricate-lineolate, but sometimes smooth and shiny, as in *Anthidium utahense* Swenk, 1914. Thus, the variation among species is described for the distal portion of the propodeal triangle.

The colour of the sternal scopa, punctation of terga, and shape of T6 provide useful characters in separating species. In most species the scopa is pale but in some it is entirely dark brown to black. There is little variation in the scopal colour within species, except in *Anthidium atrifrons* Cresson, 1868 (see species account). The discs of T1–T5 (or T1–T6 in the male) are usually elevated, sometimes visible only laterally. The punctation of the disc is usually heterogeneous, with small and large punctures, these often coarser than on the depressed marginal zone (Figs 22–27). The depressed marginal zone is usually punctate throughout and broader medially, unless otherwise indicated in the descriptions and keys; the size and density of the punctures usually vary among species. The distal margin is sometimes smooth and shiny,



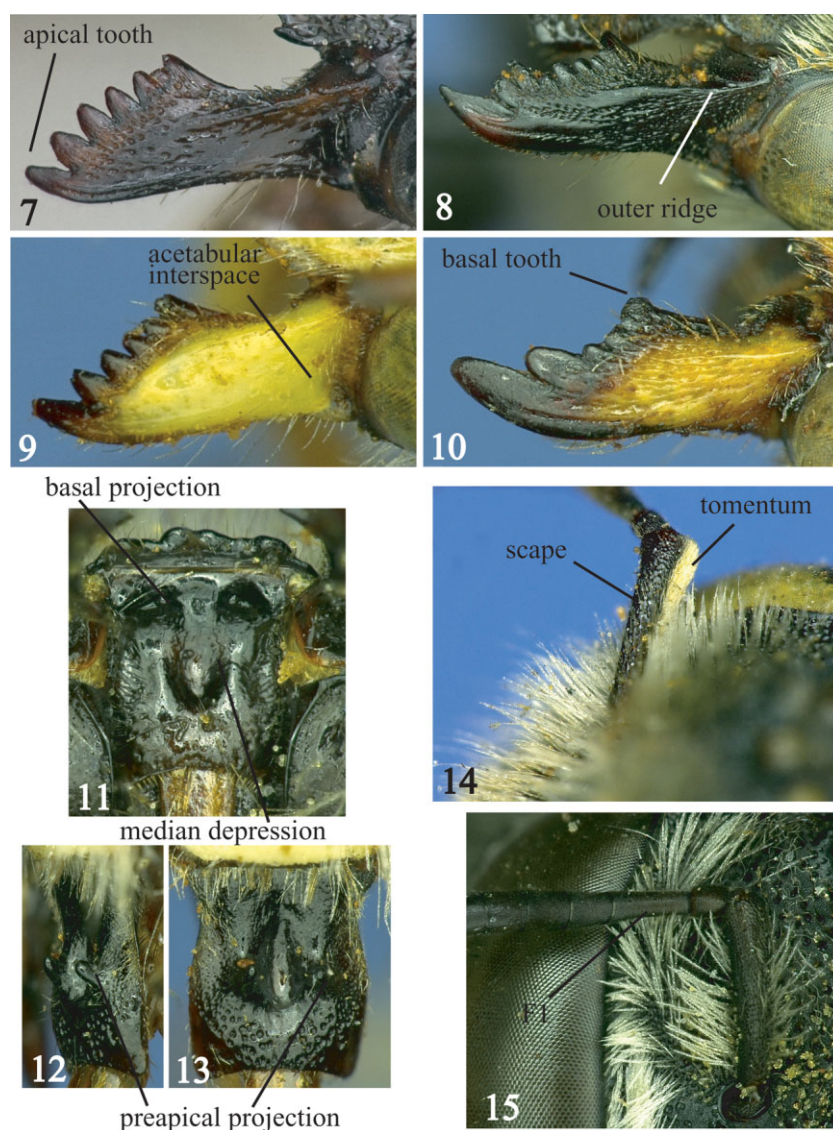
**Figure 6.** Clypeus of *Anthidium* females with distal margin strongly thick (A, B), moderately thick (C), and thin (D): A, *Anthidium adriani*; B, *Anthidium sparsipunctatum* sp. nov.; C, *Anthidium vigintipunctatum*; D, *Anthidium weyrauchi*.

and differentiated from the depressed marginal zone (e.g. Figs 22, 23); it is usually broadest on T1, but is absent in some species. The density and size of the punctures as well as the thickness and width of the distal margin are frequently used in the descriptions and keys. To facilitate comparisons, the width of the distal margin is measured on T3 or T4, and either expressed relative to a puncture width from the depressed marginal zone or as a proportion of the maximum width of the depressed marginal zone. T6 is usually more strongly and densely punctate than preceding terga; it usually has a lateral tooth, angle, or shoulder (Figs 28–33), often continuing medially into a minutely crenulate preapical carina (Figs 30, 32). The distal margin is usually projected as a depressed rim, usually thin, smooth, and shining, notched or emarginate medially (herein referred to as the median emargination), sometimes sublaterally projecting into a lobe (Fig. 31); the presence or absence and the shape of the depressed apical rim are usually good diagnostic characters. The preapical carina is strong and also submedially projected as a tooth in *A. rodriguezi*, hiding the small, median emargination of the depressed apical rim; in contrast, the preapical carina is nearly absent in *Anthidium formosum* Cresson, 1878, and the distal margin is strongly projected as a lobe or angle, with a deep median emargination; thus, the apparent apical teeth of T6 may have different origins, and we make this distinction in the descriptions and keys. The median emargination is reduced or absent in *Anthidium tenu-*

*iflorae* Cockerell, 1907 (Fig. 202), and modified into a spine in *A. espinosai* and *Anthidium nigerrimum* Schrottky, 1910 (Figs 156, 179). Internally, the shape of the distal apodeme of T6 (visible only after dissection) varies among species groups, as shown in Figures 32 and 33. This character has not been used in the systematics of Anthidiini or explored in other genera of the tribe, and might prove useful in reconstructing their phylogenetic history. It was not possible to employ this character herein because of the lack of specimens for dissection for many species.

In the male, most diagnostic characters are found in the metasoma, especially on the terminal segments and genitalia (Figs 34–38, 41–48). However, modified hairs on the ventral surface of mesepisternum, metepisternum, and hind coxa (Figs 38, 39), as well as a small spine on the hind coxa and trochanter (Fig. 40), are present in some species. T6 has a lateral spine (Fig. 34), sometimes small and hidden by hairs. T7 is strongly developed and usually trifid, with a median and two lateral projections (Figs 35, 36). Herein, the lateral projection is referred to as the lateral lobe, although in many cases it is spiniform or digitiform; likewise, the median projection is often called median spine, even though sometimes it is not spiniform. The emargination between the inner margin of the lateral lobe and the apex of the median spine is called submedian emargination. The lateral lobe varies greatly in shape and width, and is usually compared with the width of the submedian emargination in the keys and diagnosis. Unless otherwise

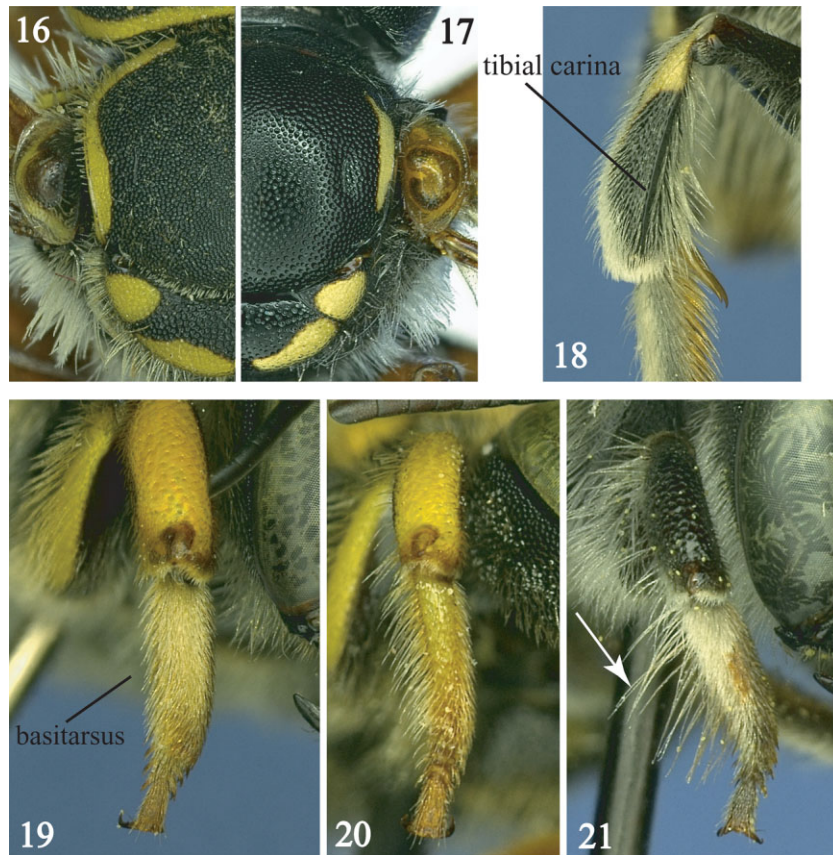




**Figures 7–15.** Outer surface of mandible (7–10), labrum (11–13), and antenna (14, 15) of *Anthidium* females: 7, *Anthidium clypeodentatum*; 8, *Anthidium rodriguezi*; 9, *Anthidium paroselae*; 10, *Anthidium sonorensis*; 11, *Anthidium peruvianum*; 12, 13 *Anthidium banningense*; 14, scape of *A. psoraleae* in profile; 15, *Anthidium parkeri* sp. nov.

indicated, the width of the lateral lobe is measured at its base. A spiniform submedian projection is also present in some species (Fig. 37). S4 often has a distinct, midapical brush of black or reddish brown hairs (apical brush of S4) on the distal margin (Figs 41, 42), varying in width and density among species; in some species, a similar brush is also found on S3 (Fig. 38). S5 is usually broadly concave on the median two-thirds or more of the distal margin (Fig. 43), except in *A. maculosum* and *Anthidium parkeri* sp. nov.: in those species the distal margin is straight, or nearly straight. This sternum is not as variable as the remaining segments, and is thus omitted from the descriptions. S6 is usually subrec-

tangular (Fig. 44), with a lateral spine or lobe; the distal margin is straight, convex, medially projected into a lobe or emarginate. The structural correspondence between T7 and S6 of the male and T6 of the female was studied in detail by Toro & Rodríguez (1997) on 13 Chilean species. During copulation, the projections of T7 of the male push the S6 of the female down, whereas T6 of the female fits into the depressions of S6 of the male, thus allowing the male genitalia entry to the genital atrium of the female. S7 is weakly sclerotized medially, thus forming two separated, well-sclerotized plates, herein called hemisternites (Fig. 45); the distal margin of the hemisternite is diagnostic for some species, being truncate, broadly



**Figures 16–21.** *Anthidium* female. Dorsum of mesosoma showing differences in puncture density (16, 17), outer surface of hind tibia showing the longitudinal carina (18), and outer surface of fore basitarsus (19–21), showing the presence or absence of dense tomentum and the fringe of long hairs. Tomentum is used to absorb extrafloral trichome secretions, and the fringe of hairs is used to excavate nests in sandy soils: 16, *Anthidium meloi* sp. nov.; 17, *Anthidium vigintipunctatum*; 18, *Anthidium porterae*; 19, *Anthidium placitum*, outer surface of basitarsus densely covered by tomentum (integument not visible among hairs); 20, *Anthidium mormonum*, outer surface of basitarsus without tomentum (integument clearly visible among hairs); 21, *Anthidium palliventris*, arrow points to the fringe of long hairs.

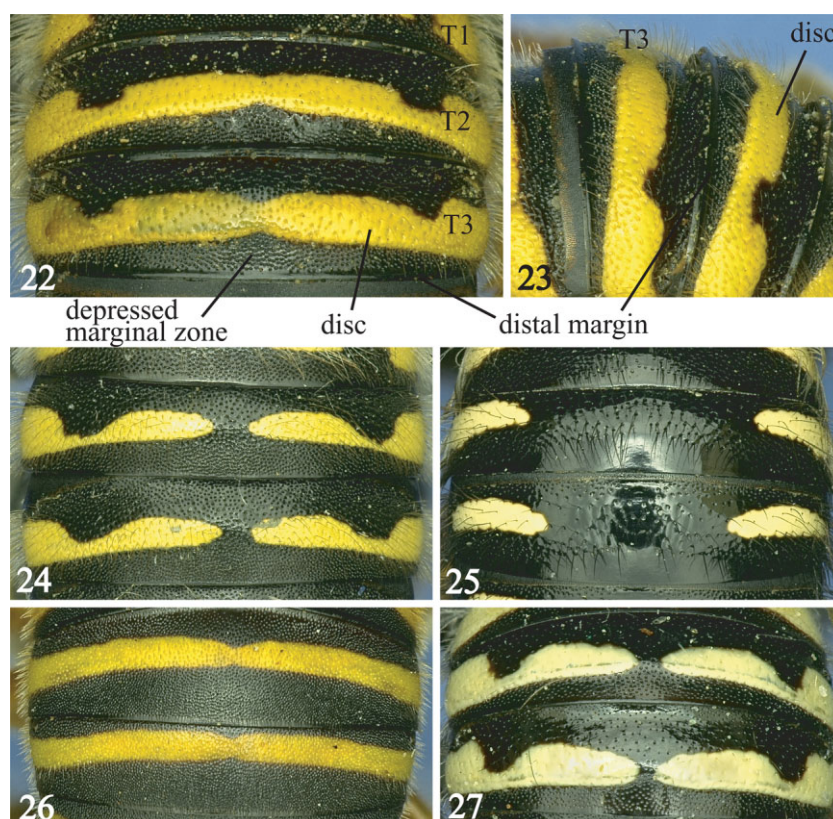
rounded, or notched. S8 is usually moderately elongate (Fig. 46), with the distal margin usually projecting into a long, sometimes bifid process. The genitalia is rather simple, with the articulation between the gonostylus and gonocoxite distinct (Figs 47, 48). The hairy gonostylus is usually finger- or club-shaped, nearly straight, or ventrally curved in profile. The penis valve is usually as long as or shorter than the gonostylus, with the inner margin ribbed basally, as seen in ventral view; in profile, the penis valve is nearly straight basally or gently curved, with the apex strongly or gently curved ventrally, thus roughly S-shaped; in some species, the apex is unusually long (e.g. Fig. 38), sometimes with a preapical medial projection and a dorsal patch of hairs (Figs 47, 48). The apex of the penis valve also varies in shape among species or species groups, as described in character 91 of the phylogenetic analysis

(see below). The volsella is usually present, triangular, sometimes well-developed, dorsally or ventrally projected.

#### FLORAL RECORDS, PHENOLOGY, AND BIOGEOGRAPHY

Information on distribution, floral records, and seasonality were extracted from literature and data from specimen labels. Most floral associations do not distinguish between bees visiting for pollen or nectar, but when available, confirmed pollen records according to literature are indicated by an asterisk. Where a plant genus was represented by records at both the genus level and species level, generic records were not listed. Plants used as source of nesting material (i.e. trichomes) are listed in the biology section with other information on the nest. In general, the taxonomic status for plant species in North America follows that



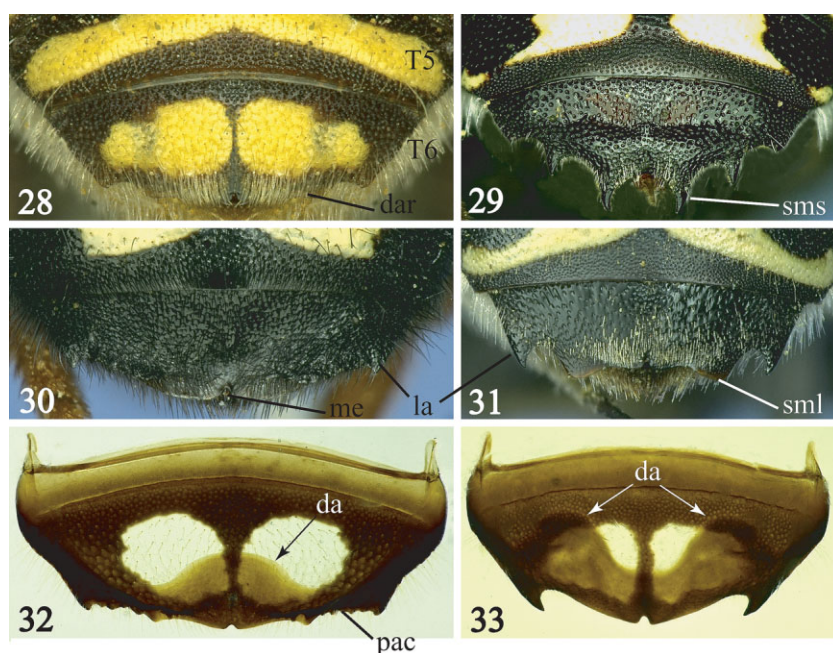


**Figures 22–27.** Dorsal views (except 23) of the three basal terga of *Anthidium* females: 22, 23, *Anthidium duomarginatum* sp. nov., dorsal and profile views, the discal area of this species is strongly elevated and the distal margin is distinctly thickened, doubly carinate, as seen in the profile view; 24, *Anthidium collectum*; 25, *Anthidium danunciae* sp. nov.; 26, *Anthidium hallinani*; 27, *Anthidium emarginatum*.

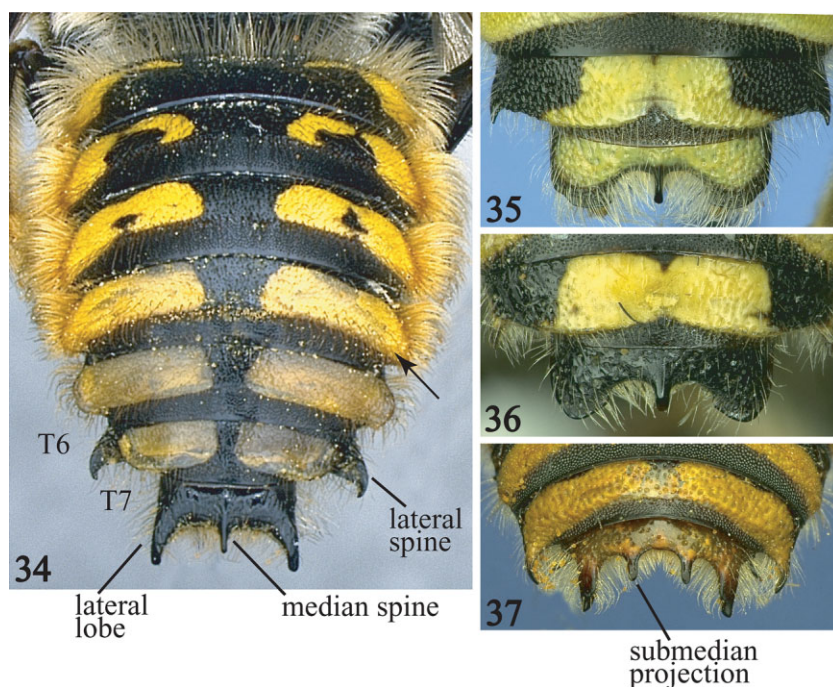
used in the PLANTS database (USDA & NRCS, 2010), whereas the higher-level classification follows the proposal of the APG system (Stevens, 2009). Phenologies for rarely collected species are simply recorded as months; more detailed descriptions are provided where larger samples and/or systematic collections in specific locations have been conducted across the flowering season.

Elevation ranges given in the species account are round to the nearest 100 m a.s.l. Distribution maps were generated with ARCMAP 9.3. Biogeographical patterns were analysed using the World Wildlife Fund Ecoregion coverage (Olson *et al.*, 2001) in Arc-GIS. The ecoregions, which often conform to physiographic units, are frequently named by the dominant vegetation type (e.g. Colorado Plateau shrublands = Colorado Plateau; they are sometimes referred to in the species accounts by the former). Because we were not always able to locate site data on labels, and therefore were unable to georeference them, lists of ecoregions in the species accounts should not be considered inclusive. They do represent occurrence in those ecoregions.

**PHYLOGENETIC ANALYSIS AND CHARACTER TRACING**  
To explore the phylogenetic relationships among subgenera and New World species of *Anthidium*, we built a data matrix in WINCLADA (Nixon, 1999), consisting of 97 characters for two out-group species and 103 in-group species (Appendix S1). The majority of characters are binary (~87%), and were coded from all tagmata of the adult body in the female; however, all characters in the male were coded from the metasoma, except for two coded from the mesosoma. Twelve characters are based on colour. Twenty-one characters are present in both sexes (e.g. tibial carina); to avoid duplication these were only coded for the female. Thus, this data set was not sex-biased because the number of characters coded only for the females ( $n = 40$ ) are about the same as those coded only for the males ( $n = 36$ ). Based on the phylogenetic studies of Müller (1996b) and Gonzalez (2008), we chose a distant taxon [*Trachusa larreae* (Cockerell, 1897)] and closely related taxon [*Afranthidium capicola* (Brauns, 1905)] of *Anthidium* as out-groups. Species were chosen based on availability. For each subgenus we chose two species, including the type species, and in the case of

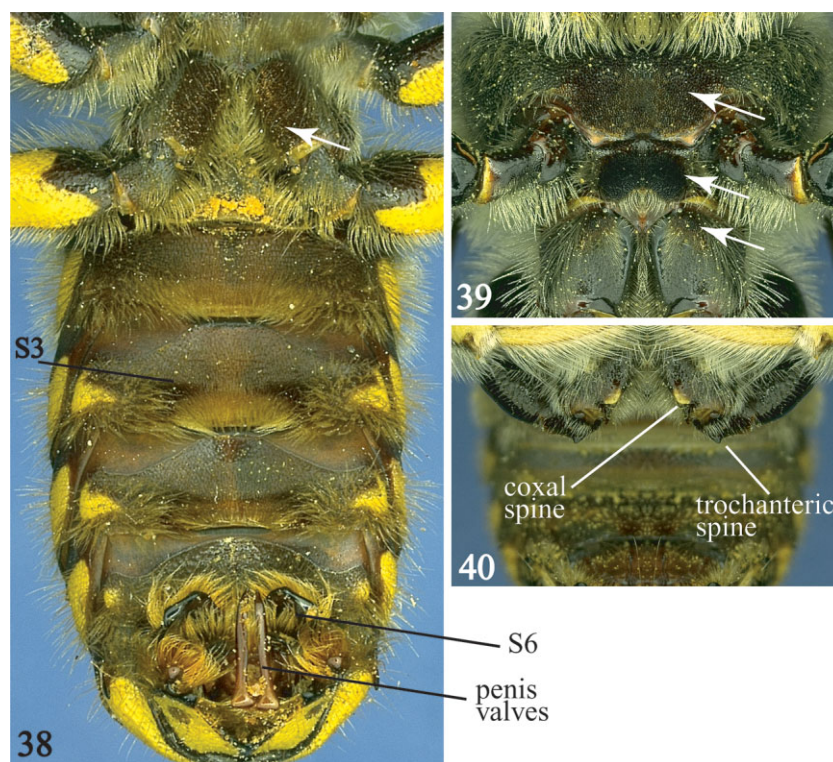


**Figures 28–33.** Dorsal (28–31) and ventral (32, 33) views of the sixth tergum of *Anthidium* females: 28, *Anthidium utahense*; 29, *Anthidium multispinosum* sp. nov.; 30, *Anthidium mapuche* sp. nov.; 31, *Anthidium schwarzi* sp. nov.; 32, *Anthidium maculifrons*; 33, *Anthidium banningense*. Abbreviations: da, distal apodeme; dar, depressed apical rim; la, lateral angle; me, median emargination; pac, preapical carina; sml, submedian lobe; sms, submedian spine; T, tergum.



**Figures 34–37.** Dorsal view of metasoma (34) and detail of distal terga (35–37) of *Anthidium* males: 34, *Anthidium manicatum*, arrow points to the lateral protuberances of terga; 35, *Anthidium michenerorum* sp. nov.; 36, *Anthidium platyfrons* sp. nov.; 37, *Anthidium insignissimum*.





**Figures 38–40.** Modifications of the middle and hind coxae and metasoma of *Anthidium* males (ventral view); white arrows point to the dense, stout, simple dark-brown hairs covering the flat ventral surface of hind coxa and the mesepisternum and metepisternum in some species (38, 39). A small spine is sometimes also present on the hind tibia and trochanter (40): 38, *Anthidium illustre*; 39, *Anthidium chamelense* sp. nov.; 40, *Anthidium maculifrons*.

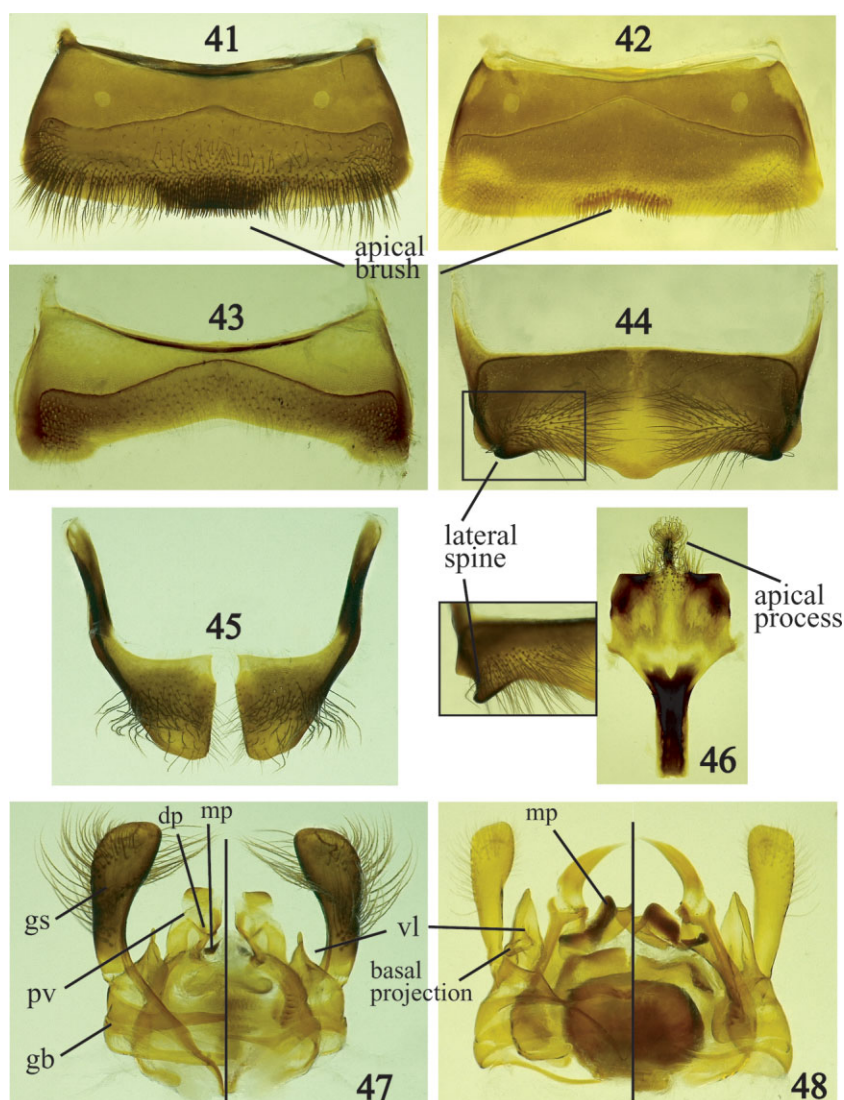
*Anthidium* s.s., species previously separated subgenerically but now synonymized according to the classification of Michener (2007). Eleven OW *Anthidium* and all NW species recognized in the present work were included in the analysis.

Parsimony analyses were carried out in Tree Analysis Using New Technology (TNT; Goloboff, Farris & Nixon, 2003). All characters were treated as non-additive and equally weighted. Tree search in TNT was performed by implementing sectorial searches (SSs) with tree drifting (TD) and tree fusing (TF), and ratchet runs with TD and TF. We used the following search: keep a maximum of 10 000 random trees, 500 random-addition sequences, and 1000 ratchet iterations, including 100 cycles of TD and 100 rounds of TF per iteration. Branch robustness was estimated with 10 000 bootstrap replicates (Felsenstein, 1985) and Bremer support (Bremer, 1994) in TNT. The latter search was performed by withholding 10 000 sub-optimal trees up to 10 steps longer than the most parsimonious tree.

We used the strict consensus tree to trace the possible evolutionary pattern of characters associated with pollen collecting from nototribic flowers, namely characters 7 (presence of wavy, curved, or hooked hairs

on the female clypeus) and 13 (presence of coarse integument on the female frons, Fig. 5E). We also mapped the presence of dense tomentum on the outer surface of the fore basitarsus in females (character 36, Fig. 19), a character associated with absorption of extrafloral trichome secretions. To explore larger biogeographical patterns in *Anthidium*, we mapped the presence of a hind tibial carina (character 37, Fig. 18), a character of interest because such a carina is found in most Palaearctic *Anthidium* s.s. If the presence of such carinae is correlated with other characters supporting monophyletic groups, tracing its possible evolutionary path might shed some light on the origins of the NW taxa. Trees were visualized and printed in WinClada, collapsing unsupported nodes and using DELTRAN (slow) for character optimization; when the choice is equally parsimonious, the latter favours repeated origins of characters over reversals. The abbreviations L, CI, and RI are used for tree length, and for consistency and retention indices, respectively. Character matrix and resulting trees were deposited in TreeBASE and are available at <http://purl.org/phylo/treebase/phylo/trees/study/TB2:S14050>.

The following are the characters used in the phylogenetic analysis. Characters coded for the female



**Figures 41–48.** Ventral view of fourth (41, 42), fifth (43), sixth (44), seventh (45), and eighth (46) sternum, and genital capsule (47, 48), in dorsal (left half) and ventral (right half) views of *Anthidium* males: 41, 47, *Anthidium atripoides* sp. nov.; 42, 48, *Anthidium macushi* sp. nov.; 43, *Anthidium clypeodentatum*; 44, *Anthidium mapuche* sp. nov., with an enlargement of the lateral spine in anteroventral view; 45, *Anthidium danunciae* sp. nov.; 46, *Anthidium andinum*. Abbreviations: dp, dorsoapical patch of hairs; gb, gonobase; gs, gonostylus; mp, medial projection; pv, penis valve; vl, volsella.

that also apply to the male ( $n = 21$ ) are indicated with an asterisk.

#### FEMALE

1. Clypeus with basal margin (between subantennal sutures): (0) about as long as its lateral margin (e.g. Fig. 102); (1) shorter than its lateral margin (e.g. Fig. 103).
2. Clypeal colour: (0) entirely yellow or cream; (1) black with yellow or cream maculations; (2) entirely black, without maculations.
3. Disc of clypeus: (0) gently convex; (1) strongly convex; (2) distinctly flat (e.g. Figure 5E).
4. Thickness of clypeal margin: (0) thin (e.g. Figs 6D, 97–99); (1) thick (e.g. Figs 6A, 68, 70).
5. Shape of clypeal margin: (0) without distinct tubercles or teeth (e.g. Figs 107, 117); (1) strongly tuberculate (e.g. Figs 93, 96); (2) with distinct tubercles or teeth sublaterally (e.g. Figs 73, 75, 77).
6. Clypeus with distinct median emargination on distal margin: (0) absent; (1) present (e.g. Fig. 73).



7. Clypeus with modified hairs (i.e. non-plumose hairs distinctly hooked, wavy, or curved apically): (0) absent; (1) present (e.g. Fig. 5E). These modified hairs are associated with the collection of pollen from nototribic flowers. There are some sparse, curved hairs on the female clypeus of *Anthidium chilense* Spinola, 1851 and *A. utahense*, but they are not as dense and distinct as in other species that possess such modified hairs. Thus, these species were coded as having character state 0.
8. Inferior paraocular area: (0) entirely yellow or cream; (1) black with yellow or cream maculations; (2) entirely black, without maculations.
9. Antennal sockets: (0) at about middle of eyes; (1) below middle of eyes.
10. \*Antenna: (0) dark brown to black, not ferruginous; (1) ferruginous.
11. Posterior surface of scape with dense tomentum: (0) absent; (1) present (Fig. 14).
12. F1: (0) short, at most 0.9× combined lengths of F2 + F3; (1) elongate, at least as long as combined lengths of F2 + F3 (Fig. 15).
13. Integument of frons: (0) unmodified, smooth, and shiny between contiguous punctures; (1) modified, dull between coarse and sparse punctures (Fig. 5E).
14. Vertex: (0) with complete yellow or cream band, sometimes medially broken; (1) with oval or rounded spot behind compound eye, rarely absent.
15. Preoccipital border: (0) rounded, not carinate; (1) carinate laterally, behind gena.
16. Mandible with more than four small, acute teeth on distal margin: (0) absent; (1) present (Figs 8–10). This type of mandible is only present in eight anthidiine genera grouped into series B *sensu* Michener (2007), and is presumably associated with wool-carding behaviour.
17. Mandible with upper teeth: (0) about the same size as remaining teeth, not reduced; (1) smaller and often reduced, thus mandibular margin appearing concave between the large middle and basal teeth.
18. \*Labral fossa: (0) absent; (1) present (Figs 11–13).
19. Labrum with basal projections: (0) absent; (1) present (Fig. 11).
20. Size of basal labral projections: (0) small, not distinctly projecting; (1) large, distinct, visible even when mandibles closed (Fig. 11).
21. Labrum with a pair of preapical projections: (0) absent; (1) present (Figs 12, 13).
22. Size of labral preapical projections: (0) small, not distinctly projecting; (1) large, distinct (Figs 12, 13).
23. Labrum with a single, small mid-apical projection: (0) absent; (1) present.
24. \*Pronotal lobe: (0) rounded, not distinctly carinate or lamellate; (1) with distinct carina or lamella.
25. Colour of pronotal lobe: (0) black or dark brown with yellow or cream maculations; (1) without yellow or cream maculations, not ferruginous; (2) ferruginous.
26. \*Colour of tegula: (0) not ferruginous; (1) ferruginous.
27. \*Omaulus: (0) rounded, not carinate or lamellate; (1) carinate or lamellate, at least basally as in *A. oblongatum*.
28. \*Punctures of scutum: (0) contiguous or nearly so (Fig. 16); (1) not contiguous, spaced with large impunctate spaces (Fig. 17).
29. \*Axilla with lateral carina: (0) absent; (1) present.
30. Colour of axilla: (0) entirely yellow or with yellow or cream maculations; (1) dark brown to black without maculations.
31. \*Distal margin of scutellum as seen from above: (0) rounded (Figs 16, 17); (1) truncate.
32. \*Scutellum with distinct carina or lamella, at least laterally as in *A. oblongatum*: (0) absent; (1) present.
33. \*Scutellum in profile: (0) not greatly overhanging metanotum; (1) greatly overhanging metanotum.
34. Scutellum: (0) with yellow or cream maculations; (1) without yellow or cream maculations.
35. \*Colour of fore tibia: (0) not ferruginous; (1) ferruginous.
36. Tomentum on fore basitarsus covering integument: (0) absent (Fig. 20); (1) present (Figs 19, 21).
37. \*Hind tibia with distinct longitudinal carina on outer surface: (0) absent; (1) present (Fig. 18).
38. Hind tibia with hairs distinctly shorter and thicker than those on anterior margin: (0) absent; (1) present.
39. Hind basitarsus: (0) elongate,  $\geq 3.0\times$  longer than broad; (1) short and broad,  $\leq 2.0\text{--}2.7\times$  longer than broad.
40. \*Arolia: (0) absent; (1) present.
41. \*Colour of veins of forewing basally: (0) not ferruginous; (1) ferruginous.
42. Position of basal vein with respect to cu-v in the forewing: (0) confluent with cu-v; (1) not confluent with cu-v, several widths basal to cu-v.
43. Colour of sternal scopa: (0) mostly whitish or yellowish, at least laterally; (1) dark brown to black.
44. \*Discal area of T2–T4: (0) not elevated; (1) strongly elevated (Figs 22, 23); (2) weakly elevated laterally (Figs 24–27).
45. \*Discal area of T2–T5 with integument: (0) imbricate or punctate; (1) glossy (Fig. 25).
46. \*Punctures on discal area of T2–T4: (0) dense, distance between punctures  $\leq 1.0\text{--}1.5\times$  PW

- (Fig. 26); (1) sparse, distance between punctures  $\geq 2.0 \times$  PW (Fig. 25, 27).
47. \*Depressed marginal zone: (0) absent; (1) present (Fig. 22).
  48. \*Punctures on depressed marginal zone: (0) present throughout (e.g. Fig. 24); (1) absent medially, punctures present laterally only (Fig. 25).
  49. Density of punctures on depressed marginal zone, medially: (0) dense, distance between punctures  $\leq 1.0\text{--}1.5 \times$  PW; (1) sparse, distance between punctures  $\geq 2.0 \times$  PW.
  50. \*Fascia on depressed marginal zone of T2–T5: (0) absent; (1) present.
  51. \*Distal margin of T2–T5: (0) simple, not thickened or doubly carinate; (1) thickened, doubly carinate (Figs 22, 23).
  52. Width of impunctate distal margin of T2–T5: (0) narrow,  $\leq 1.0\text{--}1.5 \times$  PW; (1) wide,  $\geq 3.0\text{--}4.0 \times$  PW to about one-third of depressed marginal zone maximum width; (2) very wide, at least half of depressed marginal zone maximum width.
  53. T4 width: (0) about as wide as T1, metasoma thus parallel-sided; (1) narrower than T1, metasoma ovoid or nearly so.
  54. T6 in profile: (0) not strongly concave; (1) strongly concave, as in *A. oblongatum*.
  55. T6 with distinct lateral spine: (0) absent (e.g. Fig. 139); (1) present (e.g. Fig. 140).
  56. T6 with submedian spine: (0) absent; (1) present (e.g. Fig. 151).
  57. T6 with median emargination: (0) reduced or absent (e.g. Fig. 202); (1) present, small, much less than one-fifth of tergal width (e.g. Fig. 160); (2) present, large, about one-fifth of tergal width (e.g. Fig. 162). The median emargination in some species with distinct submedian spines such as *A. peruvianum* is reduced or absent, and do not correspond to the space between the spines. Thus, we coded these species as having character state 0.
  58. T6 with median spine: (0) absent; (1) present (e.g. Fig. 179).
  59. T6 with midapical margin distinctly projected: (0) absent; (1) present (Fig. 141).
  60. T6 with distinct broad submedian lobe on distal margin: (0) absent; (1) present (Fig. 31).
  61. T6 with depressed apical rim laterally projecting into a ventral lobe: (0) absent; (1) present (Fig. 190).
  62. Venter of mesepisternum with short, stout hairs: (0) absent; (1) present (Fig. 39).
  63. Hind coxa with ventral surface depressed, with short, stout hairs: (0) absent; (1) present (Fig. 38).
  64. T4–T5 with distinct lateral spine: (0) absent; (1) present.
  65. T6 with distinct lateral spine: (0) absent; (1) present.
  66. T6 with distinct preapical carina: (0) absent; (1) present.
  67. T7: (0) not narrowed apically, lateral lobes separated, not beneath median spine (Fig. 214); (1) narrowed apically, lateral lobes close together beneath median spine present (Fig. 210).
  68. T7 with distinct lateral lobe: (0) absent; (1) present.
  69. Shape of lateral lobe of T7: (0) triangular or subtriangular (e.g. Fig. 229); (1) oblongate or nearly so (Fig. 254); (2) distinctly long and narrow, spiniform or digitiform (e.g. Figs 208, 210); (3) rectangular or nearly so, outer margin straight, apex somewhat obliquely truncate (e.g. Figs 207, 225); (4) rectangular or nearly so, outer margin straight, apex rounded, not obliquely truncate (e.g. Figs 212, 214); (5) elongate, somewhat rectangular with distinctly curved apex (e.g. Fig. 258); (6) short, broadly rounded (e.g. Figs 215, 224); (7) short, subquadrate (Figs 243, 279).
  70. T7 with median apical spine: (0) absent or reduced (e.g. Fig. 242); (1) present (e.g. Fig. 243).
  71. T7 with submedian projection: (0) absent; (1) present (e.g. Fig. 37).
  72. S3 with dense apical brush of hairs on distal margin: (0) absent; (1) present.
  73. Distal margin of S4: (0) straight or nearly straight (e.g. Fig. 291); (1) distinctly concave (e.g. Fig. 285).
  74. S4 with dense apical brush of hairs on distal margin: (0) absent; (1) present.
  75. Width of apical brush of S4: (0) about one-fifth to one-sixth of sternal width (e.g. Fig. 296); (1) about one-third of sternal width (e.g. Fig. 292); (2) at least half of sternal width (e.g. Fig. 286).
  76. Colour of apical brush of S4: (0) dark brown to black; (1) yellowish to reddish brown.
  77. S6 with distinct median emargination on distal margin: (0) absent; (1) present (e.g. Fig. 333).
  78. S6 with distinct median longitudinal carina on disc: (0) absent; (1) present (Figs 372, 391).
  79. S6 with distinct lateral lobe or spine: (0) absent; (1) present.
  80. Lateral projection of S6: (0) small, spiniform, laterally directed (e.g. Fig. 334); (1) long, acute, forming a distinct lobe (e.g. Fig. 336).
  81. S6 with distinct medial lobe or spine: (0) absent (e.g. Fig. 335); (1) present (e.g. Fig. 334).
  82. Median lobe of S6: (0) small, triangular, spiniform (e.g. Fig. 334); (1) large, rectangular, broad (e.g. Fig. 336).

#### MALE

62. Venter of mesepisternum with short, stout hairs: (0) absent; (1) present (Fig. 39).
63. Hind coxa with ventral surface depressed, with short, stout hairs: (0) absent; (1) present (Fig. 38).

83. S8 medially with distinct apical process: (0) absent; (1) present (e.g. Fig. 46).
84. Apical process of S8: (0) stalked, long, narrow (e.g. Fig. 510); (1) not stalked, broad, apically bifid (e.g. Fig. 489); (2) triangular or nearly so (e.g. Fig. 487); (3) rectangular or subquadrate (e.g. Figs 499, 519); (4) distinctly broader at apex, sometimes bifid (e.g. Figs 525, 527).
85. S8 with stalked apical process distinctly bifid: (0) absent; (1) present (e.g. Fig. 522).
86. Spiculum of S8: (0) distinctly elongate, narrower than disc; (1) not distinctly elongate, about as broad as disc (e.g. Fig. 524). The spiculum is basally broad in *A. formosum* (Fig. 514) and *Anthidium illustre* Cresson, 1879 (Fig. 520), but we coded these species as having character state 0.
87. Length of penis valve (in ventral view): (0) shorter than gonostylus (Fig. 565); (1) about as long as or slightly longer than gonostylus (e.g. Fig. 564); (2) distinctly longer than gonostylus, clearly visible without dissection (Fig. 38).
88. Bases of penis valves: (0) broad, fused together; (1) not broad and fused together, widely separated by distinct bridge.
89. Penis valve with the inner margin ribbed basally, as seen in ventral view: (0) absent; (1) present (e.g. Fig. 47).
90. Penis valve bridge with lateral projection: (0) absent; (1) present (Fig. 570).
91. Apex of penis valve: (0) broad, short, flattened (e.g. Figs 47, 568); (1) narrow, pointed, spiniform (e.g. Figs 565, 566); (2) narrow, pointed, flattened, not spiniform (e.g. Fig. 48); (3) narrow, digitiform or nearly so (e.g. Fig. 564); (4) flattened, not pointed, broader than gonostylus as in *Anthidium meloi* sp. nov. (Fig. 570).
92. Apex of penis valve: (0) straight or nearly straight; (1) strongly or gently curved ventrally.
93. Apex of penis valve distinctly divided into lobes or projections: (0) absent; (1) present.
94. Penis valve with preapical medial projection: (0) absent or reduced; (1) present (Fig. 48).
95. Size of preapical medial projection of penis valve: (0) small (Fig. 47); (1) large, distinct (Fig. 48).
96. Volsella: (0) absent; (1) present (Fig. 47).
97. Length of volsella (in ventral view): (0) about one-third or less of gonostylus length (Fig. 47); (1) at least half of gonostylus length (Fig. 48).

## RESULTS

### GENUS *ANTHIDIUM* FABRICIUS, 1804

**Diagnosis:** Species of *Anthidium* in the NW are usually robust, brightly maculated megachiliform bees with

body size ranging from small (e.g. *A. utahense*, ~6 mm) to very large, about the size of a carpenter bee, genus *Xylocopa* Latreille, 1802 (e.g. *Anthidium chamelense* sp. nov. and *A. rodriguezi*, 13–20 mm). *Anthidium* can be distinguished from other NW Anthidiini by the following combination of characters (both sexes, unless otherwise indicated): female mandible multidentate, with five or more teeth separated by acute notches (Figs 7–10); labrum with median longitudinal depression or fossa (Fig. 11); juxtantennal carina absent; arolia absent; base of propodeal triangle usually minutely punctate, dull, hairy, without series of pits; postspiracular fovea of propodeum absent; forewing with basal vein several widths basal to cu-v; female T6 usually with depressed apical rim and median emargination (Figs 28–31); male T6 usually with distinct lateral spine or projection (Figs 34–37) (reduced to nearly absent in *A. rodriguezi*); penis valves of male genitalia widely separated by distinct bridge basally, ventrally with inner margin basally ribbed, apically often divided into lobes or projections. The combination of arolia absent and multidentate mandible with four or usually more sharp teeth is sufficient to distinguish female *Anthidium* from all other NW anthidiine genera.

### SUBGENUS *ANTHIDIUM* FABRICIUS, 1804

*Anthidium* Fabricius, 1804: 367. Type species: *Apis manicata* Linnaeus, 1758, by designation of Latreille, 1810: 439.

*Callanthidium* Cockerell, 1925a: 365. Type species: *Anthidium illustre* Cresson, 1879, by original designation (**new synonym**).

*Tetranthidium* Moure, 1947: 15. Type species: *Anthidium latum* Schrottky, 1902, by original designation.

*Stenanthidium* Moure, 1947: 16. Type species: *Anthidium espinosai* Ruiz, 1938, by original designation.

*Melanthidium* Cockerell, 1947: 106, not *Melanthidium* Pasteels, 1969a: 90. Type species *Melanthidium carri* Cockerell, 1947 (= *A. rodriguezi* Cockerell, 1912), by original designation.

*Anthidium* (*Melanoanthidium*) Tkalcû, 1967: 91. Type species: *Anthidium montanum* Morawitz, 1864, by original designation.

*Anthidium* (*Echinanthidium*) Pasteels, 1969a: 101. Type species: *Anthidium echinatum* Klug, 1832, by original designation.

*Anthidium* (*Ardenthidium*) Pasteels, 1969a: 103. Type species: *Anthidium ardens* Smith, 1879, by original designation.

*Anthidium* (*Pontanthidium*) Pasteels, 1969a: 105. Type species: *Anthidium pontis* Cockerell, 1933, by original designation.

*Anthidium* (*Morphanthidium*) Pasteels, 1969b: 423. Invalid name. No type species designated. Based on the description and the included species, this subgenus was the same as *Ardenanthidium*.

*Comments:* *Callanthidium* was originally proposed as a genus by Cockerell (1925b) and rendered as a subgenus of *Anthidium* by Griswold & Michener (1988). The greatly elongated penis valves of the male, as well as the broad median emargination of T6 in the female, are distinctive characters that separate the two species placed in *Callanthidium* from most *Anthidium*. However, according to our phylogenetic analyses (see results below), such characters are homoplasies and are also present in the male of *A. edwini* and females of *Anthidium chubuti* Cockerell, 1910, *A. edwini*, *Anthidium michenerorum* sp. nov., and *Anthidium penai* Moure, 1957. The recognition of *Callanthidium* clearly renders *Anthidium* s.s. paraphyletic, and thus is here relegated to the status of species group within the large and diverse subgenus *Anthidium* s.s.

#### BIOLOGY OF NEW WORLD *ANTHIDIUM*

Little is known about the biology of *Anthidium* in the NW. Except for the works of Krombein (1967) and Parker (1987) using trap nests, most records are isolated observations, sparsely reported in the literature. Interestingly, the most complete research on the biology of *Anthidium* in the Americas so far is that of Kurtak (1973) on the invasive species *A. manicatum*. Information on the nesting biology exists for 14 native *Anthidium* species (16.7%), all of them from North America (Table 1). To date, 20 species of insect nest associates (ten families of three orders) and one species of fungus have been recorded from *Anthidium* nests. *Anthidium* seem to nest in any pre-existing available burrow in the ground or wood, including abandoned tunnels of coleopterans, and nests of bees or wasps. The only known exception is *A. palliventris*, which may dig its own burrows (Hicks, 1928), but an unidentified species was also observed digging a shallow nest in friable soils in the Colorado Plateau of Utah (T.L. Griswold, pers. observ.). The inner walls of the tunnel are usually lined with trichomes scraped from the stems and leaves of pubescent plants, such as some Asteraceae of the genera *Artemisia*, *Cirsium*, and *Pseudognaphalium* (see species accounts). The same material is used to build a single, short row of cells (usually between one and four) or, depending on the available space, sometimes two rows, as has been recorded for *A. formosum* and *A. maculosum* (Hicks, 1929a; Krombein, 1967). At least in those two species and also in *A. illustre*, and unlike most aculeate

hymenopterans, cells containing males are located at the bottom of the tunnel (older cells); adult males are also usually larger than the females, in contrast to most bees. The upper portion of the burrow, above the cells, is filled with packs of trichomes or other materials, such as pebbles, small pieces of wood, masticated plant material, or even pellets of lizard dung (Krombein, 1967). The type of material used as the nest plug seems to vary among species, and in some cases within species. For example, *Anthidium porterae* Cockerell, 1900 (Hicks, 1926; Custer & Hicks, 1927) seems to use only pebbles, whereas *A. illustre* may use all of the aforementioned materials (Hicks, 1929b; Parker, 1987). Given the limited information on the nesting habits, it would not be surprising that other materials, such as leaves, may be used. The female mandible of the South American species *Anthidium insignissimum* Strand, 1910 has a distinct transverse ridge at the base of the basal teeth that runs parallel with the fimbriate line, on the inner surface of the mandible. Such a ridge, also present to some extent in *A. meloi* sp. nov., is not developed in other *Anthidium*, but is commonly found in some species of *Osmia* Panzer, 1806 and *Megachile* Latreille, 1802 that exhibit leaf-cutting behaviour. The nesting biology of the South American species of *Anthidium* remains to be explored. Male territorial behaviour has been observed for a number of North American *Anthidium*, including *Anthidium banningense* Cockerell, 1904 (Jaycox, 1967b), *A. maculosum* (Alcock, Eickwort & Eickwort, 1977), *Anthidium palmarum* Cockerell, 1904 (Wainwright, 1978), *A. palliventris*, and *A. porterae* (Villalobos & Shelly, 1991), and the adventive *A. manicatum* (Pechuman, 1967). Males occupy patches of floral resources where they mate; larger males are more successful in mating, at least in some species.

Based on the records compiled from the literature and specimen labels, floral associations for native NW *Anthidium* include 53 plant families and over 100 species. Asteraceae, Boraginaceae, and Fabaceae are the families most frequently recorded (see species account); however, associations are largely for North America, and do not distinguish between flower visits for pollen versus nectar. Some common, widespread species such as *Anthidium mormonum* Cresson, 1878 and *A. utahense* seem to be polylectic, but others, based on the presence of modified structures on their faces, may be specialized for pollen collecting from nototribic flowers. Such morphological adaptations include distinctly flat areas of the face, with rugose integument and stiff, hooked, or wavy hairs (e.g. Fig. 5E). A total of 21 species, including *A. manicatum*, exhibit at least one of these adaptations (Table 2).



**Table 1.** Summary of some features of known nesting biologies for New World species of *Anthidium* (see also species accounts)

Species	Location	N	C	CD (mm)	NP	S	Associated organisms	References
<i>A. emarginatum</i> *	California	–	1–7	–	T	G	<i>Leucospis affinis</i> Say <sup>8</sup> <i>Monodontomerus montivagus</i> Ashmead <sup>11</sup> <i>Physoccephala texana</i> (Williston) <sup>5</sup> <i>Sphaerophthalma unicolor</i> (Cresson) <sup>10</sup> <i>Chrysus florissanticola</i> Rohwer <sup>5</sup> <i>Dioxys producta</i> (Cresson) <sup>9</sup> <i>C. coloradica</i> Bohart <sup>6</sup> <i>M. montivagus</i> <sup>11</sup> <i>S. blakeii</i> (Fox) <sup>10</sup> <i>S. orestes</i> (Fox) <sup>10</sup> <i>S. unicolor</i> <sup>10</sup> <i>C. tripartita</i> Aaron <sup>6</sup> <i>D. pomonae</i> Cockerell <sup>9</sup> <i>D. producta</i> <sup>9</sup> <i>Tricrania stansburyi</i> Haldeman <sup>3</sup> <i>D. producta</i> <sup>9</sup> <i>Tragidion armatum</i> LeConte <sup>1</sup> <i>Ascosphaera</i> sp. <sup>4</sup> <i>Trichodes ornatus</i> Say <sup>2</sup> <i>S. unicolor</i> <sup>10</sup>	Davidson (1895)
<i>A. banningsense</i>	Logan, UT	–	–	–	–	G		Jaycox (1967b); Grigarick & Stange (1968)
<i>A. collectum</i>	Pasadena, CA	> 2	–	–	P, M	G		Hicks (1929c)
	Antioch, CA	–	1–4	–	P, T	G		Ferguson (1962)
	–	–	–	–	–	–		Grigarick & Stange (1968)
	–	–	–	–	–	–		Hurd (1979)
<i>A. edwardsii</i>	–	1	–	–	–	W		Grigarick & Stange (1968); Hurd (1979)
<i>A. formosum</i>	Carey, ID	3	2	20.0–22.0/5.0–9.0	P, R	TN		Horning (1969)
	Logan Canyon, UT	12	1–4 (3.2)	13.6–15.4/8.0–10.0	M	TN		Parker (1987)
<i>A. illustre</i>	Denver, CO	–	2–4	20.8/8.0	R	G		Johnson (1904)
	Pasadena, CA	≥ 3	2–10†	–	M, P, R	W		Hicks (1929b)
	Santa Clara, UT	4	2–4 (3.2)	17.2–19.0/10.0	M, P	TN		Parker (1987)
	Glendale, CA	1	–	–	–	–		Ferguson (1962)
<i>A. maculifrons</i> *	Kansas	2	1	–	T	G		Hungerford & Williams (1912)
<i>A. maculosum</i>	Portal, AZ	12	5–12†	12.0–17.0 (13.5)/6.4–12.7	T, P, M	TN		Krombein (1967)
	Verdi, NV	1	–	–	–	W		Parker & Bohart (1966)
	Montague, CA	–	–	–	–	–		Horning (1971)
	Pasadena, CA	25	1–4 (1.4)	–	P, T	W		Hicks (1929a)
<i>A. paroselae</i>	Mesilla Park, NM	1	–	–	T	G		Newberry (1900)
<i>A. palliventre</i>	Newport Beach, CA	1	–	–	–	G		Hicks (1928)
<i>A. porterae</i>	Point East, CO	1	1	25.0/–	P	G		Hicks (1926)
	Point East, Base Line Lake, CO	≥ 3	2	–	P	G		Custer & Hicks (1927)
<i>A. tenuiflorae</i>	Longs Peak, CO	1	–	–	P	G	<i>C. lauta</i> Cresson <sup>6</sup>	Custer (1928)
<i>A. utahense</i>	Logan, UT	–	1–4 (2.1)	–	P	G, TN	<i>D. producta</i> * <sup>9</sup>	Hicks (1926)
								Jaycox (1966)

Columns: location, all localities are in the USA; N, number of nests examined; C, number of cells per nest (when available, an average is given in parentheses); CD, cell dimensions, maximum length/width (average in parentheses); NP, type of material used in the nest plug (P, pebbles; R, resin; T, trichomes, indicated as cotton or down in literature; M, masticated plant material mixed with pebbles, dirt, or other organic debris); S, nesting substrate (G, ground; TN, trap nest; W, wood, i.e. stems or flower stalks, empty holes in wood, etc.). Associated organisms: COLEOPTERA, (1) Cerambycidae, (2) Cleridae, (3) Meloidae; FUNGI, (4) Ascosphaeraceae; DIPTERA, (5) Conopidae; HYMENOPTERA, (6) Chrysididae, (7) Halictidae, (8) Leucospidae, (9) Megachilidae, (10) Mutillidae, (11) Torymidae; \*Species identity or host association needs to be confirmed. †Some nests had cells arranged in two columns.

**Table 2.** New World *Anthidium* species, including *A. manicatum*, with specialized structures on the female face for collecting pollen from nototribic flowers (see also species accounts)

Species	Flat face	Modified integument	Clypeus	Modified hairs		
				Parocular area	Supraclypeus	Frons
<i>A. alsinai</i>	+	+	+	+	+	+
<i>A. andinum</i> *	+	+	+	+	+	+
<b><i>A. cafayate</i> sp. nov.</b>	—	+	+	—	+	+
<b><i>A. calchaqui</i> sp. nov.</b>	+	+	+	—	+	+
<b><i>A. chamelense</i> sp. nov.*</b>	+	+	+	+	+	+
<i>A. cochimi</i>	—	—	+	—	—	—
<b><i>A. duomarginatum</i> sp. nov.</b>	—	—	+	—	—	—
<i>A. edwardsii</i>	—	—	+	—	+†	—
<i>A. formosum</i>	—	—	+	—	+†	—
<i>A. illustre</i>	—	—	+	—	+†	—
<b><i>A. kolla</i> sp. nov.</b>	—	—	+	—	+	+
<i>A. maculosum</i> *	+	+	+	+	+	+
<b><i>A. macushi</i> sp. nov.</b>	—	—	+	—	+†	—
<i>A. manicatum</i>	—	—	+	+	+	—
<b><i>A. michenerorum</i> sp. nov.</b>	—	—	+	—	+	—
<i>A. pallidiclypeum</i>	—	—	+	—	+†	—
<b><i>A. parkeri</i> sp. nov.*</b>	+	+	+	+	+	+
<i>A. placitum</i>	—	—	+	+	+†	—
<b><i>A. platyfrons</i> sp. nov.</b>	+	—	+	+	+†	—
<i>A. porterae</i>	—	—	+	—	+†	—
<i>A. rodriguezi</i> *	+	+	+	+	+	+

Although *A. chilense* and *A. utahense* have some sparse, curved hairs on the clypeus, these species are not included here because those hairs are not as distinctly modified as in the other species listed. \*Maculosum group: the female of *A. alsinai* is unknown but the male face is modified, as in the species of this group. Modified integument refers to dull integument with coarse and sparse punctures, as in Figures 5B–E. Modified hairs refers to simple, erect, apically curved, hooked, or wavy hairs. + or –, presence or absence of a character. †Modified hairs only present apically.

#### KEY TO THE NORTH AMERICAN SPECIES OF *ANTHIDIUM* (FEMALES)

Here, North America is used in the broad sense, meaning from Canada to Panama. Unless otherwise indicated, bands or spots refer to yellow or cream maculations. Additional characters that are not unique but are useful in the identification of some species are indicated in parentheses. The following species appear twice in the key because of the variation in diagnostic characters: *A. atrifrons*, *Anthidium pallidiclypeum* Jaycox, 1963, *Anthidium platyfrons* sp. nov., and *Anthidium rodecki* Schwarz, 1934. In *A. atrifrons* the hair colour of the sternal scopa and legs ranges from black or dark brown to white; in *A. rodecki*, the distinct fringe of long hairs on the fore basitarsus may be broken off and the discal area of terga is not strongly elevated in some specimens; the median clypeal emargination is usually distinct in *A. pallidiclypeum* but is weak in some specimens; the presence or absence of white tomentum on the fore and mid basitarsi of *A. platyfrons* sp. nov. is uncertain because of the poor condition of the available specimens.

1. Pronotal lobe strongly lamellate; scutellum, next to axilla, produced to tooth or angle; T6 strongly concave in profile (introduced).....*Anthidium (proanthidium) oblongatum*
- Pronotal lobe not lamellate, rounded or at most with sharp border; scutellum, next to axilla, without tooth or angle; T6 not strongly concave in profile.....2
- 2(1). T6 with deep median emargination on distal margin, about one-fifth as wide as tergum (Figs 157, 162) (preapical carina absent).....3
- T6 with much smaller median emargination on distal margin, sometimes nearly absent (e.g. Figs 132, 202) (preapical carina usually present, at least laterally).....4
- 3(2). T6 distinctly elevated along midline, dark brown to black along median elevation and distal margin, otherwise yellow; preapical labral projections low to nearly absent.....*Anthidium formosum*

- T6 not elevated along midline, usually with large sublateral dark brown to black spot; preapical labral projections present, distinct.....*Anthidium illustre*
- 4(2). Hind tibia with distinct longitudinal carina on anterior margin (Fig. 18), sometimes difficult to see it when integument is yellow .....5
- Hind tibia without longitudinal carina on anterior margin .....17
- 5(4). Frons with sparse punctures (1–2× PW), integument dull, sparsely covered with simple, apically curly or hooked hairs (e.g. Fig. 5E).....6
- Frons with punctures nearly contiguous (e.g. Fig. 5A), integument smooth and shiny between punctures, densely covered with branched, unmodified hairs .....9
- 6(5). Distal margin of T6 laterally with a tooth or angle, without submedian teeth (Figs 171, 184); metasoma with maculations; medium-sized bees ( $\leq 12$  mm in body length).....7
- Distal margin of T6 with four teeth, submedian teeth present in addition to lateral teeth (Figs 138, 195); metasoma without maculations or largely reduced to sides of basal terga; large bees ( $\geq 15$  mm in body length).....8
- 7(6). T1–T5 with wide, flanged impunctate margins; T6 slightly depressed above preapical carina (as seen in profile), with distinct, acute lateral projection in dorsal view (Fig. 171); fore and mid basitarsi with outer surfaces densely covered by white tomentum (integument not visible among hairs); dull surface of face restricted to frons; tergal margins reflexed, widely impunctate.....*Anthidium maculosum*
- T1–T5 with narrow impunctate margins that are in the same plane as rest of the segment; T6 rather straight in profile, with indistinct lateral projection in dorsal view (Fig. 184); fore and mid basitarsi with outer surfaces not densely covered by white tomentum (integument largely visible among hairs); dull surface of face extending from frons onto paraocular area; tergal margins unmodified, not as above.....*Anthidium parkeri* sp. nov.
- 8(6). T6 with rounded lateral angle, preapical carina with semicircular emargination on median third, about as wide as distance between apices of lateral and submedian teeth (Fig. 138).....*Anthidium chameleense* sp. nov.
- T6 with distinct lateral spine, preapical carina with wider and shallower emargination on nearly median half, about twice as wide as distance between apices of lateral and submedian teeth (Fig. 195).....*Anthidium rodriguezi*
- 9(5). Clypeus with strong teeth or tubercles on entire convex distal margin (Fig. 93); terga with bands broadly interrupted medially, progressively closer towards apical terga, forming distinctive black, broad V-shaped area across terga (as in Fig. 34); clypeus densely covered with apically hooked hairs (if specimen not worn) (introduced).....*Anthidium manicatum*
- Clypeus without strong teeth or tubercles on non-convex distal margin or gently wavy between strong sublateral tubercles or teeth (e.g. Figs 114, 119); terga with bands forming different pattern, not as above; hairs on clypeus modified or unmodified.....10
- 10(9). T1–T5 with discal areas strongly elevated, depressed marginal zones coarsely punctate, distal margins distinctly thickened, usually doubly carinate (as in Figs 22, 23); T6 with preapical carina distinct, minutely crenulate (teeth might be worn out in some specimens) (Fig. 32).....11
- T1–T5 with discal areas not strongly elevated, visible only laterally or not elevated at all, depressed marginal zones finely and densely to weakly and sparsely punctate, distal margins not thickened or doubly carinate; T6 with preapical carina reduced or absent.....14
- 11(10). Preoccipital border sharp, nearly carinate; T6 (Fig. 192) with distal margin rounded or nearly so, depressed apical rim surpassing preapical carina (sometimes hidden by hairs), visible in dorsal view across all its length (Mexico).....*Anthidium quetzalcoatl*
- Preoccipital border narrowly rounded, but not sharp; distal margin of T6 somewhat truncate, not rounded, depressed apical rim entirely or partially hidden by preapical carina in dorsal view (Figs 142, 170, 190).....12
- 12(11). T6 with depressed apical rim laterally projecting into a distinct ventral lobe (Fig. 190); disc of T6 distinctly elevated along midline; preapical labral projections long and distinct (as in Figs 12, 13).....*Anthidium porterae*
- T6 with distal margin not strongly projected into a ventral lobe (Figs 142, 170); disc of T6 not distinctly elevated along midline; preapical labral projections reduced to tubercles to nearly absent.....13
- 13(12). Clypeus with unmodified hairs on disc, distal margin tuberculate, recessed between sublateral tubercles (Fig. 90); disc of clypeus with medial longitudinal crest, with welts along crest; preapical labral projections small but distinctly curved.....*Anthidium maculifrons*
- Clypeus with erect, simple, apically curved hairs on disc, distal margin non-tuberculate, not recessed between low sublateral tubercles (Fig. 62); disc of clypeus without medial longitudinal crest or welts; preapical labral projections absent, barely indicated by elevated border on lateral margin of labral furrow.....*Anthidium cochimi*
- 14(10). Clypeus prominently convex, distal margin usually gently tuberculate laterally (Fig. 81); terga dull, finely and densely punctate, especially on T4 (Fig. 26).....15



- Clypeus weakly convex, nearly flat, distal margin distinctly smooth, not tuberculate (Figs 107, 122); terga shinier, weakly, sparsely punctate ..... 16
- 15(14). T6 with depressed marginal rim only visible medially, median emargination continuing basally into a short carina (Fig. 161); tegula ferruginous (Costa Rica, Panama, Mexico).....*Anthidium hallinani*
- T6 with depressed marginal rim visible almost across all its length, median emargination not continuing into a carina (Fig. 136); tegula dark brown to black with yellow markings (Mexico).....*Anthidium aztecum*
- 16(14). Mandible with apical tooth pointed, not much broader than remaining teeth (Fig. 9); T6 with distal margin not distinctly projecting medially (Fig. 185).....*Anthidium paroselae*
- Mandible with apical tooth parallel-sided, much broader than remaining teeth (Fig. 10); T6 with distal margin distinctly projecting medially (Fig. 199).....*Anthidium sonorensense*
- 17(4). Clypeus with distinct medial emarginate angle on distal margin (Figs 73, 103, 110); disc of clypeus mostly covered by simple, apically curly or hooked hairs (if specimen not worn)..... 18
- Clypeus without distinct emargination on distal margin, although sometimes gently concave (e.g. Fig. 57); disc of clypeus covered by normal or modified hairs..... 20
- 18(17). Clypeus without acute sublateral teeth on distal margin (Fig. 103); depressed marginal zone of T5 sparsely punctate medially (2–3× PW).....*Anthidium pallidiclypeum* (in part)
- Clypeus with distinct, acute sublateral teeth on distal margin (Figs 73, 110); depressed marginal zone of T5 densely punctate, punctures contiguous or nearly so..... 19
- 19(18). Fore and mid basitarsi with outer surfaces densely covered by tomentum, integument not visible among hairs (as in Fig. 19); T6 with distinct lateral angle, depressed apical rim clearly visible in dorsal view (Fig. 188); terga shiny, maculations sparsely punctate.....*Anthidium placitum*
- Fore and mid basitarsi with outer surfaces not densely covered by tomentum, integument largely visible among hairs; T6 without distinct lateral angle, depressed apical rim not clearly visible in dorsal view (Fig. 153); terga dull, maculations densely punctate.....*Anthidium edwardsii*
- 20(17). Fore and mid basitarsi with outer surfaces, at least basally, densely covered by tomentum, integument not visible among hairs (as in Fig. 19)..... 21
- Fore and mid basitarsi with outer surfaces not densely covered by tomentum, integument largely visible among hairs (as in Fig. 20)..... 40
- 21(20). T6 with lateral angle acute, strongly projected (e.g. Figs 31, 33, 176)..... 22
- T6 with lateral angle not acute, not strongly projected (e.g. Figs 132, 133)..... 24
- 22(21). T6 with broad submedian lobe on distal margin (Fig. 31); discs of T1–T5 dull, finely reticulate between sparse, fine punctures (1–3× PW).....*Anthidium schwarzi* sp. nov.
- T6 without broad submedian lobe on distal margin (Fig. 33); discs of T1–T5 shiny, smooth or nearly so between coarse, dense punctures ( $\leq 1 \times$  PW)..... 23
- 23(22). T6 with acute lateral projection (Fig. 33); hind basitarsus black, outer surface densely covered with whitish tomentum (integument not visible among hairs).....*Anthidium banningsense*
- T6 with blunt lateral projection (Fig. 176); hind basitarsus yellow, outer surface not densely covered with whitish tomentum (integument largely visible).....*Anthidium michenerorum* sp. nov.
- 24(21). Sternal scopa dark brown to black; legs usually with dark-brown to black hairs..... 25
- Sternal scopa entirely, or at least laterally, pale or yellowish (best seen in profile); tibiae and tarsi usually with white hairs on outer surface, inner surface with dark-brown to yellowish hairs..... 28
- 25(24). Depressed marginal zones of T3–T5 finely and feebly punctate medially (1–3× PW); distal margins of T3–T5 dull and not or little differentiated from rest of depressed marginal zone (usually robust and large bees, ~9–10 mm)..... 26
- Depressed marginal zones of T3–T5 (Fig. 27) usually coarsely and densely punctate medially ( $\leq 1 \times$  PW); distal margins of T3–T5 with narrow but distinct, smooth and shiny border (usually slender and smaller bees, 8 mm or less)..... 27
- 26(25). Clypeus with broadly thickened distal margin, lateral margin obtuse (Fig. 54); mandible with five teeth; scutellum black; fore basitarsus sparsely covered with short tomentum, thus segment appearing slender, with long semierect, unbranched hairs, at least along outer margin.....*Anthidium atripoides* sp. nov.
- Clypeus with thin distal margin (Fig. 53); mandible with six teeth; scutellum usually with pair of light maculations; fore basitarsus covered with denser and longer tomentum, thus segment appearing more robust, with shorter semierect, unbranched hairs.....*Anthidium atripes*
- 27(25). T6 with depressed apical rim ending just before lateral angle (Fig. 155); fore basitarsus sparsely covered with short tomentum, thus segment appearing slender (less than width of tibia), with long semierect, unbranched hairs, at least along outer margin (T6 usually black).....*Anthidium emarginatum*
- T6 with depressed apical rim progressively disappearing about halfway between median emargination and lateral angle (Fig. 132); fore basitarsus covered with denser and longer tomentum, thus segment appearing more robust (as wide as width of tibia), with shorter semierect, unbranched hairs (T6 usually maculated).....*Anthidium atrifrons* (in part)

- 28(24). T6 with distinct broad submedian lobe on distal margin (Fig. 183); tibiae usually light reddish-brown.....*Anthidium palmarum*
- T6 without submedian lobe on distal margin (e.g. Fig. 182); tibiae entirely yellow or black with yellow markings.....29
- 29(28). Fore basitarsus with fringe of long hairs (1.5–2× basitarsal width) along posterior margin (Fig. 21) (species usually associated with sand dune areas).....30
- Fore basitarsus without fringe of long hairs on posterior margin or fringe short ( $\leq$  basitarsal width).....31
- 30(29). Fringe of fore basitarsus with hairs about twice as long as width of basitarsus; tibiae dark brown to black, usually without yellow markings; terga with medially interrupted bands, laterally deeply notched on anterior margin; T1–T5 coarsely and densely punctate on discs (2–3× PW), depressed marginal zones with denser punctures ( $\leq 1.0\times$  PW), distal margins narrow (1–2× PW).....*Anthidium palliventre*
- Fringe of fore basitarsus with shorter hairs, about as long as width of basitarsus; tibiae entirely yellow; terga with complete bands, medially notched on anterior margin (sometimes medially interrupted on T1); T1–T5 finely and sparsely punctate on discs (4–5× PW), depressed marginal zones with fine punctures as on discs, slightly denser (2–3× PW), distal margins broad, about one-third of depressed marginal zones, broadest on T1 (slightly narrower than depressed marginal zone).....*Anthidium rodecki* (in part)
- 31(29). T1–T5 with discal areas strongly elevated (Fig. 22) (all terga with complete bands, sometimes medially interrupted on T1).....32
- T1–T5 with discal areas not strongly elevated.....33
- 32(31). Clypeus with some apically curved or wavy hairs on disc; T1–T5 smooth and shiny between coarse punctures, with distal margins distinctly thickened, doubly carinate (Fig. 22); T6 with depressed apical rim narrow, barely visible in dorsal view (Fig. 152).....*Anthidium duomarginatum* sp. nov.
- Clypeus with unmodified hairs on disc; T1–T5 dull or weakly shiny, finely imbricate between fine punctures, with distal margins not thickened or doubly carinate; T6 with depressed apical rim broad, distinct in dorsal view (Fig. 194).....*Anthidium rodecki* (in part)
- 33(31). Depressed marginal zone of T3 finely and sparsely punctate medially ( $\geq 2\times$  PW) (terga dull).....34
- Depressed marginal zone of T3 coarsely and densely punctate medially ( $\leq 1\times$  PW).....35
- 34(33). Disc of T6 distinctly convex, distal margin truncate (Fig. 147); fore basitarsus sparsely covered with short tomentum, thus segment appearing slender, with long semierect, unbranched hairs, at least along outer margin (mandible usually black).....*Anthidium dammersi*
- Disc of T6 somewhat flat, especially on sides, distal margin broadly angled medially (Fig. 143); fore basitarsus covered with denser and longer tomentum, thus segment appearing more robust, with shorter semierect, unbranched hairs (mandible yellow).....*Anthidium cockerelli*
- 35(33). Clypeus and inferior paraocular area distinctly flat, covered by hooked hairs (Fig. 111); fore basitarsus sparsely covered with short tomentum, thus segment appearing slender, with long semierect, unbranched hairs, at least along outer margin.....*Anthidium platyfrons* sp. nov. (in part)
- Clypeus and inferior paraocular area not distinctly flat, covered by normal hairs (except in *A. pallidiclypeum*); fore basitarsus covered with denser and longer tomentum, thus segment appearing more robust, with shorter semierect, unbranched hairs (except in *A. pallidiclypeum*).....36
- 36(35). Distal margins of T4 and T5 with a narrow but distinct smooth and shiny impunctate border (about 1–3× PW wide); terga usually distinctly shiny, smooth or nearly so between punctures.....37
- Distal margins of T4 and T5 with a very narrow impunctate border, at most as wide as a puncture width (Fig. 24); terga duller, finely imbricate to reticulate between punctures.....38
- 37(36). Clypeus prominently convex (Fig. 52) (mandible, clypeus, and inferior paraocular area often yellow); T6 with distinct median emargination (Fig. 132).....*Anthidium atrifrons* (in part)
- Clypeus weakly convex, nearly flat (Fig. 125) (face and mandible usually black); T6 with median emargination absent or weakly sinuate (Fig. 202).....*Anthidium tenuiflorae*
- 38(36). Fore basitarsus sparsely covered with short tomentum, thus segment appearing slender, with long semierect, unbranched hairs, at least along outer margin; hind basitarsus yellow, outer surface not densely covered with whitish tomentum (integument largely visible among hairs).....*Anthidium pallidiclypeum* (in part)
- Fore basitarsus covered with denser and longer tomentum, thus segment appearing more robust, with shorter semierect, unbranched hairs; hind basitarsus black, outer surface densely covered with whitish tomentum, largely obscuring integument.....39
- 39(38). Clypeus with distal margin wavy, sublateral tubercle not strongly projected (Fig. 64); T6 with depressed apical rim distinct, visible along three-quarters of distal margin (Fig. 144); mandible except teeth and inferior paraocular area yellow.....*Anthidium collectum*
- Clypeus with distal margin not usually wavy, with sublateral tubercle more strongly projected, thus usually appearing gently concave in facial view (Fig. 86); T6 with depressed apical rim not as distinct as above, visible on median half or less of distal margin (Fig. 166); mandible with diffuse white markings, inferior paraocular area entirely black or with white marking not reaching above level of dorsal margin of clypeus.....*Anthidium labergei* sp. nov.

- 40(20). T6 with midapical margin narrowly projected (Figs 141, 191); scape with posterior surface densely covered with short, white tomentum (Fig. 14).....41  
 — T6 with midapical margin not narrowly projected (e.g. Fig. 177); scape with posterior surface not covered by white tomentum.....42
- 41(40). Clypeus gently convex with distinctly toothed or tuberculate distal margin (Fig. 61); T6 without a distinct lateral projection (Fig. 141).....*Anthidium clypeodentatum*  
 — Clypeus rather flat with non-tuberculate distal margin, except for sublateral tubercle (Fig. 113); T6 with distinct, acute lateral projection (Fig. 191).....*Anthidium psoraleae*
- 42(40). T6 transversely depressed on disc, with strongly projected lateral angle and four spinose projections on distal margin; depressed, translucent apical rim absent (Fig. 29).....*Anthidium multispinosum* sp. nov.  
 — T6 with disc convex or nearly so, lateral angle not strongly projected, without spinose projections on distal margin; depressed, brownish, often translucent apical rim present (e.g. Fig. 177).....43
- 43(42). Propodeum dull, integument strongly imbricate–lineolate between punctures; usually long bees ( $\geq 11$  mm in body length).....*Anthidium mormonum*  
 — Propodeum shiny, integument smooth to weakly imbricate or lineolate between punctures; smaller bees ( $\leq 8$  mm in body length).....44
- 44(43). Clypeus and inferior paraocular area distinctly flat, covered by hooked hairs (Fig. 111).....*Anthidium platyfrons* sp. nov. (in part)  
 — Clypeus distinctly convex, not on the same level as the inferior paraocular area, covered by unhooked hairs.....45
- 45(44). Clypeus and inferior paraocular area entirely black; T6 with distal margin broadly rounded (Fig. 165).....*Anthidium jocosum*  
 — Clypeus and inferior paraocular area black, usually with yellow marks; T6 with distal margin truncate (Fig. 28).....*Anthidium utahense*

KEY TO THE NORTH AMERICAN SPECIES OF *ANTHIDIUM* (MALES)

Here, North America is used in the broad sense, from Canada to Panama. Specimens should be relaxed to uncurl their metasoma for viewing S4 (for hairs on distal margin) and S6–S8 (for shape). Unless otherwise indicated, bands or spots refer to yellow or cream maculations. Additional characters that are not unique but are useful in the identification of some species are indicated in parentheses. The following species appear twice in the key because of the variation in diagnostic characters. In *A. paroselae* and *A. edwardsii* the tibial carina is sometimes weak and difficult to see because of the yellow integument; the apical brush of S4 of *A. duomarginatum* varies from black to reddish brown; the lateral lobe of T7 of *A. mormonum* varies in width (see species account). The male of *A. multispinosum* sp. nov. is unknown.

1. Pronotal lobe lamellate; scutellum, next to axilla, produced to tooth or angle; T6 with midapical projection; median spine of T7 absent (Fig. 254) (introduced).....*Anthidium (Proanthidium) oblongatum*  
 — Pronotal lobe not lamellate, rounded or at most with sharp border; scutellum, next to axilla, without tooth or angle; T6 without midapical spine; median spine of T7 present, sometimes short (e.g. Figs 211, 226).....2
- 2(1). Penis valve greatly elongate, extending anteriorly over S6 to apical brush of S4, clearly visible without dissection (Fig. 38).....3  
 — Penis valve not greatly elongate, not extending anteriorly over S6, barely visible without dissection.....4
- 3(2). Hind coxa unmodified, not distinctly depressed ventrally, covered with long, slender, branched, light hairs; T7 with median spine usually long and pointed, nearly as long as lateral lobe; outer margin of lateral lobe convex (Fig. 236).....*Anthidium formosum*  
 — Hind coxa distinctly flattened ventrally, densely covered with short, stout, simple, golden to brown hairs; T7 with median spine short and blunt, less than half length of lateral lobe; outer margin of lateral lobe usually straight (Fig. 242).....*Anthidium illustre*
- 4(2). Hind tibia with distinct longitudinal carina on anterior margin (as in Fig. 18).....5  
 — Hind tibia without longitudinal carina on anterior margin.....18
- 5(4). Frons with sparse punctures (1–2× PW), integument dull, largely visible among hairs (as in Fig. 5E).....6  
 — Frons with punctures nearly contiguous, integument smooth and shiny between punctures, often obscured by hairs.....9
- 6(5). Mesepisternum ventrally with normal hairs; F1 long and slender, at least about as long as combined lengths of F2 and F3 (as in Fig. 15); medium-sized bees ( $\leq 12$  mm in body length).....7  
 — Mesepisternum ventrally densely covered with short, stout, spines (Fig. 39); F1 short and wide, shorter than combined lengths of F2 and F3; large bees ( $\geq 15$  mm).....8
- 7(6). Lateral lobe of T7 digitiform (Fig. 247); mandible with second and third teeth about as far apart as first and second; clypeus with distal margin straight, without a midapical tubercle.....*Anthidium maculosum*



- Lateral lobe of T7 subtriangular or nearly subtriangular (Fig. 259); distance between second and third mandibular teeth about twice as long as distance between first and second; clypeus with midapical tubercle on distal margin.....***Anthidium parkeri* sp. nov.**
- 8(6). Lateral spine of T6 reduced to an angle or nearly absent; median spine of T7 pointed (Fig. 269).....***Anthidium rodriguezi***
- Lateral spine of T6 present, small, sometimes hidden by hairs in dorsal view; median spine of T7 blunt, not pointed (Fig. 217).....***Anthidium chameleense* sp. nov.**
- 9(5). Sides of T2–T5 usually strongly protuberant, densely covered by tufts of long yellowish hairs; terga with bands broadly interrupted medially, progressively narrower towards apical terga, forming distinctive black, broad, V-shaped area across terga (Fig. 34) (introduced).....***Anthidium manicatum***
- Sides of T2–T5 not protuberant, without tufts of hairs; terga with bands forming different pattern, not as above.....10
- 10(9). Disc of S6 with distinct sublateral carinae and median spine or carina (Figs 372, 391).....11
- Disc of S6 without carinae or spines but often with spines medially or laterally on margin (e.g. Figs 340, 365).....12
- 11(10). Lateral lobe of T7 rounded, about as broad as distance between its medial margin and median spine (Fig. 264); S4 with broad (about one-third of sternal width) reddish brown brush of hairs (Fig. 321); S6 with apical median lobe, median discal carina projecting into a long spine well before distal margin (Fig. 391).....***Anthidium porterae***
- Lateral lobe of T7 digitiform, narrower than distance between its medial margin and median spine (Fig. 246); S4 with narrow reddish brown brush of hairs (about one-tenth of sternal width) (Fig. 309); S6 subtruncate, without apical median lobe, median carina reaching distal margin, projecting into an angle as seen in profile (Fig. 372).....***Anthidium maculifrons***
- 12(10). S6 with distal margin broadly projected or nearly transverse, not forming a distinct median lobe (Figs 340, 365, 386).....13
- S6 with distal margin narrowly projected medially, forming a distinct median lobe or spine (e.g. Figs 357, 402).....15
- 13(12). Terga with integument shiny between fine and sparse punctures (1–3× PW); lateral lobe of T7 with lateral margin straight or nearly straight (Fig. 260).....***Anthidium paroselae*** (in part)
- Terga dull by dense and fine punctures; lateral lobe of T7 with lateral margin strongly convex (Figs 215, 240).....14
- 14(13). S4 with narrow (about one-third of sternal width) and sparse reddish brown brush of hairs (Fig. 287); lateral lobe of S6 distinctly projected beyond margin of disc in ventral view (Fig. 340).....***Anthidium aztecum***
- S4 with broader (greater than one-third sternal width) and laterally denser reddish brown brush of hairs (Fig. 305); lateral lobe of S6 not projected beyond margin of disc in ventral view (Fig. 365).....***Anthidium hallinani***
- 15(12). Lateral lobe of T7 tapering apically, usually narrower, as measured at base, than distance between its inner margin and median spine (Figs 232, 275).....16
- Lateral lobe of T7 not tapering apically, as wide as or wider than distance between its inner margin and median spine (Figs 221, 266).....17
- 16(15). Apex of median lobe of S6 anteriorly curved into a hook (Fig. 402); apical process of S8 short, broad, weakly bifid distally (Fig. 556).....***Anthidium sonorensis***
- Apex of median lobe of S6 straight, not anteriorly curved (Fig. 357); apical process of S8 long, narrow, deeply bifid distally (Fig. 510).....***Anthidium edwardsii*** (in part)
- 17(15). Lateral lobe of T7 subtriangular or nearly so (Fig. 221); S6 with lateral margin rounded, not projected into small, acute angle or spine (Fig. 346); preoccipital border rounded.....***Anthidium cochimi***
- Lateral lobe of T7 subquadrate (Fig. 266); S6 with distinct, small, acute lateral angle or spine (Fig. 393); preoccipital border sharp, nearly carinate (Mexico).....***Anthidium quetzalcoatl***
- 18(4). S4 with distinct, broad (one-third or greater than sternal width) brush of stout black hairs on distal margin (e.g. Figs 285, 308).....19
- S4 without apical brush of stout black hairs, or, if present, then small (less than or equal to one-quarter of sternal width) or reddish brown (e.g. Fig. 291).....32
- 19(18). S8 pointed or weakly bifid apically (e.g. Figs 523, 538).....20
- S8 deeply bifid apically (e.g. Figs 490, 509).....24
- 20(19). S6 with low to nearly absent lateral lobe (Figs 370, 384).....21
- S6 with distinct, acute or obliquely truncate lateral lobe (Figs 341, 348, 400).....22
- 21(20). Submedian emargination of T7, between lateral lobe and median spine, narrow, semicircular or nearly semicircular, much narrower than width of apically straight lateral lobe (Fig. 244); S4 with sparse, short, narrowly concave brush of hairs on distal margin, occupying approximately one-third width of segment (Fig. 308); S7 hemisternite distinctly notched on distal margin (Fig. 446); apical process of S8 pointed, strongly curved in profile (Fig. 523).....***Anthidium labergei* sp. nov.**

- Submedian emargination of T7 not semicircular, much broader than width of usually apically curved lateral lobe (Fig. 258); S4 with dense and long brush of hairs occupying nearly one-half width of segment (Fig. 317); S7 hemisternite pointed, not notched on distal margin (Fig. 461); apical process of S8 weakly bifid distally, gently curved in profile (Fig. 538).....*Anthidium palmarum*
- 22(20). Lateral lobe of T7 digitiform, narrower, as measured at base, than distance between its inner margin and median spine (Fig. 216); S6 obliquely truncate laterally, forming a sharp acute lateral angle and submedian angles, median lobe longer than broad (Fig. 341).....*Anthidium banningense*
- Lateral lobe of T7 not digitiform, about as wide as or wider than distance between its inner margin and median spine (Figs 223, 273); S6 rounded or obtusely truncate laterally, median lobe shorter than broad (Figs 348, 400).....23
- 23(22). Lateral lobe of T7, as measured at base, broader than distance between its inner margin and median spine (Fig. 273); S4 with dense, long brush of hair on broadly concave median emargination (Fig. 326); S6 with lateral lobe broadly rounded, without acute angle (Fig. 400); S7 hemisternite concave on distal margin (Fig. 477); apical process of S8 with diamond-shaped apex, strongly curved in profile (Fig. 554).....*Anthidium schwarzi* sp. nov.
- Lateral lobe of T7 narrower, about as wide as or slightly narrower than distance between its inner margin and median spine (Fig. 223); S4 with sparse, short brush of hairs on gently concave distal margin (Fig. 292); S6 with lateral lobe subtruncate, with acute inner angle (Fig. 348); S7 hemisternite apically truncate (Fig. 425); S8 with apical process tapering distally in ventral view, apically bent to nearly right angle, as seen in profile (Fig. 501).....*Anthidium collectum*
- 24(19). S6 with low to nearly absent lateral lobe (Figs 337, 338).....25
- S6 with distinct, acute lateral lobe (Figs 356, 359) or laterally obliquely truncate, forming a distinct lateral angle and a submedian digitiform lobe (Fig. 377).....26
- 25(24). Lateral lobe of T7, as measured at base, broader (1.5×) than distance between its inner margin and median spine, inner margin angled, thus appearing subtriangular (Fig. 213); S4 with distal margin of brush straight (Fig. 41); S6 with apex of median lobe not incised (Fig. 338).....*Anthidium atripoides* sp. nov.
- Lateral lobe of T7 longer and narrower, at most as wide as distance between its inner margin and median spine, inner margin not angled (Fig. 212); S4 with distal margin of brush broadly concave (Fig. 285); S6 with apex of median lobe weakly incised (Fig. 337).....*Anthidium atripes*
- 26(24). S4 with apical hair brush on broad and deep median emargination, about as broad as half sternal length (Fig. 312); S6 laterally obliquely truncate, with distinct lateral angle and submedian digitiform lobe, median lobe small, digitiform, slightly shorter and narrower than submedian lobe (Fig. 377).....*Anthidium michenerorum* sp. nov.
- S4 with much smaller apical hair brush, extending about median one-third of straight or weakly concave distal margin (Figs 298, 301); S6 not as above, lateral lobes widely separated, median lobe large, about as long as and broader than lateral lobe (e.g. Figs 356, 359).....27
- 27(26). T1–T5 with discal areas strongly elevated, distal margins distinctly thickened, doubly carinate (Figs 22, 23).....*Anthidium duomarginatum* sp. nov. (in part)
- T1–T5 with distal areas not strongly elevated, distal margins not thickened or doubly carinate.....28
- 28(27). Emargination of T7 between lateral lobe and median spine narrow, semicircular or nearly semicircular (Figs 36, 234, 277); apical brush of S4 with long, moderate to dense hairs (Figs 301, 320, 329).....29
- Emargination of T7 broader, not semicircular (Figs 211, 226); apical brush of S4 with short, sparse hairs (Figs 284, 295).....31
- 29(28). Face somewhat flattened, clypeus about the same level with inferior paraocular area; S6 with outer margin of lateral lobe of straight or nearly straight, median lobe broadly truncate, apically notched (Fig. 390); S8 with broad and short apical process, its maximum basal width about 0.4× of distal margin (Fig. 544).....*Anthidium platyfrons* sp. nov.
- Face not flattened, clypeus in profile clearly convex above level of inferior paraocular area; S6 with outer margin of lateral lobe angled, often concave, median lobe broadly rounded with entire distal margin (Fig. 404); S8 with longer and narrower apical process, its maximum basal width about one-third of distal margin (Figs 512, 558).....30
- 30(29). S8 with apical process broad (Fig. 512); S6 with lateral lobe somewhat obliquely truncate (Fig. 359), distance from lateral angle to apex short, margin not incurved, apex a short sharp angle; sterna usually with dark-brown to black hairs; pronotal lobe with yellow mark (rarely much reduced).....*Anthidium emarginatum*
- S8 with apical process slender (Fig. 558); S6 with narrower lateral lobe, not obliquely truncate, apically digitiform (Fig. 404); sterna with whitish hairs; pronotal lobe black, lacking yellow mark (except in specimens from Baja California, Mexico).....*Anthidium tenuiflorae*
- 31(28). Lateral lobe of T7 narrow, basally about as wide as or slightly wider (1.2×) than distance between its inner margin and median spine, narrower apically, inner margin vertical distally (parallel with median spine) (Fig. 211); S7 hemisternite with rounded distal margin (Fig. 413); terga usually smooth and shiny between punctures, depressed marginal area densely punctate medially ( $\leq 1 \times$  PW).....*Anthidium atrifrons*

- Lateral lobe of T7 much broader ( $\sim 1.5\times$ ) than distance between its inner margin and median spine, inner margin gently sloping towards spine throughout (Fig. 226); S7 hemisternite pointed on distal margin (Fig. 428); terga usually duller, finely imbricate between punctures, depressed marginal area more sparsely punctate medially ( $\geq 1\times$  PW).....*Anthidium dammersi*
- 32(18). S8 without a distinct, long, apical process, distal margin only slightly projected medially, forming a rather broad median lobe (Figs 498, 540, 546).....33
- S8 with distinct apical process (e.g. Figs 500, 532, 537).....35
- 33(32). Lateral lobe of T7 not strongly curved medially, without acute inner angle (Fig. 260); S6 with small spinose lateral projection, distal margin not projected into a distinct median lobe (Fig. 386).....*Anthidium paroselae* (in part)
- Lateral lobe of T7 strongly curved medially, with acute inner angle (Fig. 220, 265); S6 without spinose lateral projection, distal margin projected into a distinct median lobe (Figs 345, 392).....34
- 34(33). S6 with small, triangular median lobe (Fig. 345); tergal discs sparsely, finely punctate.....*Anthidium clypeodentatum*
- S6 with large, subrectangular median lobe, broader apically (Fig. 392); tergal discs coarsely, densely punctate.....*Anthidium psoraleae*
- 35(32). S8 with apex truncate or acutely angled (Figs 500, 549).....36
- S8 with apex bifid, often on long and narrow apical process (e.g. Figs 532, 537) (stalked apical process of *A. mormonum* sometimes weakly bifid to nearly simple).....37
- 36(35). Lateral lobe of T7, as measured at base, about twice as broad as distance between its inner margin and median spine (Fig. 268); S8 with distinct, long rectangular apical process (Fig. 549); T1–T5 each with continuous or medially broken bands.....*Anthidium rodecki*
- Lateral lobe of T7 at base,  $\leq 1.5\times$  as broad as distance between its inner margin and median spine (Fig. 222); S8 with short and pointed apical process (Fig. 500); T1–T5 with medially broken bands, each lateral band distinctly notched or broken, thus usually each segment with four spots.....*Anthidium cockerelli*
- 37(35). S8 with basally broad apical process, not attached to disc by long and narrow stalk (Figs 509, 537).....38
- S8 with stalked apical process, long and narrow basally (e.g. Figs 510, 543, 560).....39
- 38(37). S6 with bispinose median lobe (Fig. 383); T1–T5 with discal areas not strongly elevated, distal margins unmodified, not distinctly thickened (T7 usually with strongly curved lateral lobe, as in Fig. 257).....*Anthidium palliventre*
- S6 with entire, not bispinose median lobe (Fig. 356); T1–T5 with discal areas strongly elevated, distal margins distinctly thickened, doubly carinate (Figs 22, 23).....*Anthidium duomarginatum* sp. nov. (in part)
- 39(37). S6 with reduced to nearly absent lateral lobe, median lobe entire, not apically notched (Fig. 382); arms of bifid apical process of S8 enlarged or capitate (Fig. 536).....*Anthidium pallidiclypeum*
- S6 with distinct, acute lateral lobe (Figs 378, 389); arms of bifid apical process of S8 not enlarged or capitate (Figs 532, 543).....40
- 40(39). Lateral lobe of T7 tapering apically, usually narrower than distance between its inner margin and median spine, outer margin straight, inner margin sometimes angled (thus apex arrow-shaped) (Fig. 232); lateral lobe of S6 short, in ventral view, laterally directed, margin between lateral and median lobe straight, not semicircular (Fig. 357).....*Anthidium edwardsii* (in part)
- Lateral lobe of T7 rounded or subquadrate, not tapering apically, at least as wide as distance between its inner margin and median spine, outer and inner margins curved; lateral lobe of S6 long, in ventral view posteriorly directed, margin between lateral and median lobe deeply emarginate, semicircular (Figs 369, 378, 389, 406).....41
- 41(40). Lateral lobe of T7 subquadrate, about twice as wide as distance between its inner margin and median spine (Figs 243, 279); S4 with narrow apical brush of reddish hairs, about one-sixth sternal width (Figs 307, 330); T7 distinctly, contiguously punctate, appearing rugulose.....42
- Lateral lobe of T7 subtriangular or elongate, with rounded to slightly curved apex, not subquadrate,  $\sim 1.5\times$  the distance between its inner margin and median spine (e.g. Figs 256, 263); S4 with broader apical brush of reddish hairs, about one-quarter of sternal width (Figs 313, 315, 319); T7 shallowly, not contiguously punctate, surface appearing smooth.....43
- 42(41). S4 with dense apical brush of hairs, easily seen among sternal hairs (Fig. 330); S6 with acute lateral lobe, usually darker and more strongly sclerotized than median lobe (Fig. 406).....*Anthidium utahense*
- S4 with sparse apical brush, hardly seen among sternal hairs (Fig. 307); S6 with blunt, broader lateral lobe, often not distinctly darker or more sclerotized than median lobe (Fig. 369).....*Anthidium jocosum*
- 43(41). Median lobe of S6 narrowly rounded or subtruncate, apex often notched, lateral lobe curved, medially directed in ventral view (Fig. 389); arms of bifid apical process of S8 gently curved, as seen in posterior view (Fig. 543); eyes with inner orbits parallel.....*Anthidium placitum*
- Median lobe of S6 broadly rounded, distal margin entire, lateral lobe straight, posteriorly directed in ventral view (Fig. 378); arms of bifid apical process of S8 diverging, as seen in posterior view (Fig. 532); eyes with inner orbits diverging dorsally.....*Anthidium mormonum* (in part)



KEY TO THE SOUTH AMERICAN SPECIES OF *ANTHIDIUM* (FEMALES)

Unless otherwise indicated, bands or spots refer to yellow or cream maculations. Additional characters that are not unique but are useful in the identification of some species are indicated in parentheses. A few species appear twice in the key because of the variation in diagnostic characters. The tibial carina is sometimes weak or absent in *Anthidium friesei* Cockerell, 1911, *Anthidium cuzcoense* Schrottky, 1910, and *Anthidium masunariae* Urban, 2001; the sternal scopa ranges from entirely white to mostly brownish in *A. gayi*. The following species are not included in the key: *Anthidium alsinai* Urban, 2001, *Anthidium paitense* Cockerell, 1926, *Anthidium igori* Urban, 2001, and *Anthidium rozeni* Urban, 2001; the females of the first two are unknown, whereas the identity of the remaining species needs to be confirmed. Urban (2002) described the females of *A. igori* and *A. rozeni*, each based on a specimen from Canta, Peru. The female of *A. igori* seems to be conspecific with *Anthidium tarsoi* Urban, 2001 and it should run to that species in the key (see species account). We were not able to examine the female of *A. rozeni*, but based on the description it would run to *A. gayi*; it could be separated from that species by T6 without lateral spines (see species account).

1. Hind tibia with distinct longitudinal carina on anterior margin (as in Fig. 18).....2
- Hind tibia without longitudinal carina on anterior margin.....19
- 2(1). Clypeus with distinct teeth or tubercles on entire distal margin (Figs 83, 88, 93, 96, 121).....3
- Clypeus without strong teeth or tubercles on entire distal margin, or gently wavy medially with strong sublateral tubercles or teeth (e.g. Figs 55, 59, 66).....7
- 3(2). Clypeus densely covered with apically hooked hairs (Fig. 93); terga with bands broadly interrupted medially, progressively closer towards apical terga, forming distinctive black, broad V-shaped area across terga (as in Fig. 34) (introduced).....*Anthidium manicatum*
- Clypeus with unmodified hairs; terga with nearly complete bands, not forming a black, broad V-shaped across terga.....4
- 4(3). Preoccipital carina distinct behind gena; T6 shiny, weakly and sparsely punctate (2–3× PW), preapical carina absent (Fig. 168).....*Anthidium latum*
- Preoccipital margin of gena sharp, not carinate; T6 duller, strongly and densely punctate, punctures nearly contiguous, preapical carina present (clearly visible in posterior view) (Figs 163, 175, 198).....5
- 5(4). Clypeus depressed preapically, just above clypeal margin (better seen in profile) (Fig. 121); T6 with depressed apical rim laterally projecting into a distinct lobe (Fig. 198); outer surfaces of basitarsi not covered with dense tomentum, integument clearly visible among hairs.....*Anthidium sertanicola*
- Clypeus not preapically depressed, nearly flushed with clypeal margin, as seen in profile (Figs 83, 96); T6 with depressed apical rim not laterally projecting into a lobe (Figs 163, 175); outer surfaces of basitarsi densely covered with tomentum, integument not visible among hairs.....6
- 6(5). T2–T5 with distal margins about one-quarter of depressed marginal zone; T6 with small but acute, distinct lateral spine (Fig. 175).....*Anthidium meloi* sp. nov.
- T2–T5 with distal margins very narrow ( $\leq 1 \times$  PW), nearly absent on T5; T6 without distinct lateral spine or projection (Fig. 163).....*Anthidium insignissimum*
- 7(2). Clypeus, supraclypeal area, and frons usually flattened, sparsely covered with stiff, simple, apically curly or hooked hairs if specimen not worn (as in Fig. 5E), integument often dull or shagreened, with coarse and sparse punctures (1–2× PW); sternal scopa mostly dark brown to black, except largely whitish in *A. andinum* and, at least laterally, in *A. calchaqui* sp. nov.....8
- Clypeus, supraclypeal area, and frons convex, not flattened, often densely covered with branched, unmodified hairs, or only with apically curly or hooked hairs on clypeus, with punctures nearly contiguous, integument smooth and shiny between punctures; sternal scopa whitish to yellowish.....11
- 8(7). T6 medially projecting on distal margin, with small but distinct submedian spine (Fig. 129); tegula and legs dark brown to black; large bees (11.5–13.8 mm in body length).....*Anthidium andinum*
- T6 not medially projecting on distal margin, without submedian spine; tegula and legs largely ferruginous; smaller bees ( $\leq 11$  mm in body length).....9
- 9(8). Frons with punctures nearly contiguous (Fig. 5B); clypeus gently convex, not flattened.....*Anthidium kolla* sp. nov.
- Frons with spaced punctures (1–2× PW); clypeus not as above, barely convex to distinctly flat.....10
- 10(9). Clypeus, supraclypeal area, and frons distinctly flattened, nearly depressed in profile; modified integument and hairs on frons extending well beyond median ocellus and lateral tangent of lateral ocellus (Fig. 5D); T1 without maculations, T2–T4 with broadly interrupted bands medially, gap between bands more than length of lateral band; sternal scopa whitish laterally (best seen in profile).....*Anthidium calchaqui* sp. nov.
- Clypeus, supraclypeal area, and frons not distinctly flattened; modified integument and hairs on frons not or scarcely extending beyond median ocellus and lateral tangent of lateral ocellus (Fig. 5C); T1–T4 with narrowly interrupted bands medially, gap between bands much shorter than half length of lateral band; sternal scopa black.....*Anthidium cafayate* sp. nov.

11(7).	T6 with submedian spine on distal margin (Fig. 151).....	<i>Anthidium deceptum</i>
—	T6 without submedian spine on distal margin (e.g. Figs 164, 204).....	12
12(11).	Depressed marginal zones of T3 and T4 densely punctate medially ( $\leq 1 \times$ PW).....	13
—	Depressed marginal zones of T3 and T4 nearly impunctate or sparsely punctate medially ( $2\text{--}3 \times$ PW) (as in Fig. 25).....	17
13(12).	Depressed apical rim of T6 restricted to about median one-third or less of distal margin, as measured between lateral spines or angles (Figs 164, 204).....	14
—	Depressed apical rim of T6 projecting on about median half or more of distal margin, as measured between lateral spines or angles (Figs 167, 172, 197).....	15
14(13).	Clypeus weakly convex, with epistomal suture straight basally (Fig. 128); T6 somewhat apically truncate, laterally angled (Fig. 204).....	<i>Anthidium vigintiduopunctatum</i>
—	Clypeus prominently convex with epistomal suture convex basally (Fig. 84); T6 not apically truncate, laterally rounded (Fig. 164).....	<i>Anthidium isabellae</i>
15(13).	Clypeus strongly convex (Fig. 87); mandible with four teeth; T6 without distinct, curved lateral spine (Fig. 167).....	<i>Anthidium larocai</i>
—	Clypeus not strongly convex; mandible with six or seven teeth; T6 with small but distinct, acute lateral spine (Figs 172, 197).....	16
16(15).	Clypeus with erect, simple, apically curved hairs on disc, distal margin usually dull, non-tuberculate, flattened in profile (Fig. 92) (French Guiana; Brazil – Roraima, Surumu).....	<b><i>Anthidium macushi</i> sp. nov.</b>
—	Clypeus with unmodified hairs on disc, distal margin usually shiny, gently tuberculate, not flattened in profile (Fig. 119) (Colombia, Venezuela, Suriname).....	<i>Anthidium sanguinicaudum</i>
17(12).	Terga smooth and shiny between punctures; large bees (~13 mm in body length).....	<i>Anthidium friesei</i> (in part)
—	Terga duller, weakly shiny, finely imbricate–lineolate between punctures; smaller bees (~10 mm in body length).....	18
18(17).	T6 with distal margin distinctly truncate, not distinctly projected laterally (Fig. 174); sternal scopa mostly brownish, somewhat paler on S1 and S2 (T2–T5 with broadly interrupted bands, each lateral band notched on posterior margin).....	<i>Anthidium masunariae</i> (in part)
—	T6 with distal margin not truncate, laterally angled (Fig. 146); sternal scopa pale (T2–T5 each with four large spots).....	<i>Anthidium cuzcoense</i> (in part)
19(1).	Fore and mid basitarsi with outer surfaces densely covered by tomentum (integument not visible among hairs) (as in Fig. 19).....	20
—	Fore or mid basitarsus, or both, with outer surface not densely covered by tomentum (integument largely visible among hairs) (as in Fig. 20).....	25
20(19).	Propodeum and T1–T4 shiny, nearly smooth between punctures; large and robust bees (~13 mm in body length).....	<i>Anthidium friesei</i> (in part)
—	Propodeum and T1–T4 duller, weakly shiny, finely imbricate or lineolate between punctures; smaller bees (~10 mm in body length).....	21
21(20).	Distal margin of clypeus distinctly thickened and tuberculate, at least laterally (Fig. 65); T6 with depressed apical rim projecting on about median half or more of distal margin, as measured between lateral spines (Fig. 145).....	<i>Anthidium colliguayanum</i>
—	Distal margin of clypeus thinner, wavy (e.g. Figs 59, 66); T6 with depressed apical rim restricted to about median one-third of distal margin (e.g. Figs 139, 146).....	22
22(21).	T6 with median emargination absent or nearly so (Figs 146, 174); outer surface of hind basitarsus not densely covered by tomentum, integument visible among hairs (as in Fig. 20).....	23
—	T6 with small but distinct median emargination (Figs 139, 201); outer surface of hind basitarsus densely covered by tomentum, integument not visible among hairs (as in Fig. 19).....	24
23(22).	T6 with distal margin distinctly truncate, not distinctly projected laterally (Fig. 174); sternal scopa mostly brownish, somewhat paler on S1 and S2 (T2–T5 with broadly interrupted bands, laterally notched on posterior margins).....	<i>Anthidium masunariae</i> (in part)
—	T6 with distal margin not truncate, laterally angled (Fig. 146); sternal scopa pale (T2–T5 each with four large spots).....	<i>Anthidium cuzcoense</i> (in part)
24(22).	T6 (Fig. 139) with depressed apical rim slightly bent dorsally, as seen in profile; clypeus and inferior paraocular area pale (Fig. 59).....	<i>Anthidium chilense</i>
—	T6 (Fig. 201) with depressed apical rim not dorsally bent; clypeus and inferior paraocular area black (Fig. 124).....	<i>Anthidium tarsoi</i>
25(19).	Sternal scopa entirely, or at least laterally, pale or yellowish (best seen in profile).....	26
—	Sternal scopa dark brown to black.....	35
26(25).	Labrum with distinct basal projections, visible even when mandibles closed (Fig. 11); legs and tegula dark brown to black.....	27
—	Labrum without distinct basal projections; legs and usually tegula ferruginous.....	29

- 27(26). T6 distinctly depressed, nearly concave in profile, distal margin strongly convex between lateral and submedian spines, this distance about three times longer than distance between submedian spines (Fig. 187) ..... *Anthidium peruvianum*  
 — T6 not distinctly depressed in profile, with distal margin straight or gently convex between lateral and submedian spines, this distance about as long as or slightly longer than distance between submedian spines (Figs 200, 203) ..... 28
- 28(27). T6 with distal margin gently convex between lateral and submedian spines (Fig. 200); terga shiny, nearly smooth between punctures, distal margins of T1–T5 broad, about one-third or more of depressed marginal zone; T1 and T2 with complete bands (Chile) ..... *Anthidium spatulatum* sp. nov.  
 — T6 with distal margin straight or nearly straight between lateral and submedian spines (Fig. 203); terga weakly shiny, finely lineolate between punctures, distal margins of T1–T5 narrower, about one-quarter or less of depressed marginal zone; T1 and T2 with medially interrupted bands (Argentina, Chile) ..... *Anthidium toro*
- 29(26). T6 with broad and deep median emargination on medially projecting distal margin, lateral spine distinctly long and acute (Fig. 186) ..... *Anthidium penai*  
 — T6 not as above, with much narrower or shallower median emargination, sometimes nearly absent, distal margin not medially projecting as above, lateral spine usually shorter and broader or absent (e.g. Figs 135, 159, 193) ..... 30
- 30(29). Disc of T6 medially depressed, distinctly elevated or protuberant in profile, not flat ..... 31  
 — Disc of T6 flat or nearly so in profile, not medially depressed or protuberant ..... 33
- 31(30). T6 strongly protuberant medially, distal margin with broad, shallow median emargination, depressed apical rim broad laterally, without lateral tooth or spine (Fig. 154) ..... *Anthidium edwini*  
 — T6 distinctly depressed medially, median emargination and depressed apical rim reduced or absent, lateral spine present, distinct (Fig. 135) ..... 32
- 32(31). Clypeal margin thick, swollen (Fig. 55); T6 with distinctively yellowish, translucent lateral spine, distal margin medially projecting; antenna largely ferruginous ..... *Anthidium aymara*  
 — Clypeal margin thinner, not distinctly broad medially (Fig. 5A); T6 with lateral spine black, distal margin not medially projecting (Fig. 135); antenna mostly dark brown to black ..... *Anthidium adelphum* sp. nov.
- 33(30). T6 with broad and shallow median emargination, without distinct depressed, translucent brownish apical rim (Fig. 193); tegula dark brown to black; large bees,  $\geq 12$  mm ..... *Anthidium rafaeli*  
 — T6 with narrow and deep median emargination, with distinct depressed, translucent brownish apical rim (Figs 160, 205); tegula ferruginous; smaller bees, 9–10 mm ..... 34
- 34(33). Clypeus prominently convex (Fig. 6C); scutum and scutellum distinctly smooth and shiny between punctures (Fig. 17); T6 with truncate depressed apical rim (Fig. 205) ..... *Anthidium vigintipunctatum*  
 — Clypeus weakly convex (Fig. 80); scutum and scutellum weakly shiny, not distinctly smooth and shiny between punctures (as in Fig. 16); T6 with broadly rounded depressed apical rim (Fig. 160) ..... *Anthidium gayi* (in part)
- 35(25). T6 with submedian or median spine, or both, on distal margin, sometimes obscured by hairs (Figs 131, 156, 159, 178, 179) ..... 36  
 — T6 without submedian or median spine on distal margin (e.g. Figs 148, 149) (in *A. chubuti* the lateral spine is moved forward, near median emargination; Fig. 140) ..... 40
- 36(35). Distal margin of T6, between submedian spines, distinctly concave (Fig. 159), without median spine; labrum with distinct basal projections, visible even when mandibles are closed (as in Fig. 11) ..... *Anthidium funereum*  
 — Distal margin of T6, between submedian spines (when present), straight or nearly straight, or with median spine (Figs 131, 156, 178, 179); labrum without distinct basal projections ..... 37
- 37(36). Clypeus gently convex, distal margin thick, smooth, non-tuberculate, broader medially (Fig. 100); F1 slightly shorter than combined lengths of F2 + F3; T6 distinctly flat to nearly concave in profile, narrowed apically, without distinct lateral angle, lateral margins concave, with straight distal margin between gently curved submedian spines, median spine absent (Fig. 178); terga weakly shiny, finely lineolate (Argentina: Neuquén) ..... *Anthidium neffi* sp. nov.  
 — Clypeus prominently convex, with thinner, gently tuberculate distal margin (e.g. Fig. 51); F1 about as long as or longer than combined lengths of F2 + F3; T6 gently convex or elevated along midline in profile, distal margin broadly rounded, submedian spine small, straight (sometimes reduced or absent), median spine present (Figs 131, 156, 179); terga shiny, nearly smooth, glossy ..... 38
- 38(37). T6 with small but distinct acute lateral spine, submedian spine absent (Fig. 156) (T2–T5 usually without bands) ..... *Anthidium espinosai*  
 — T6 without distinct lateral spine, submedian spine present, sometimes reduced to nearly absent in *Anthidium atacamense* sp. nov. (Figs 131, 179) (T2–T5 with medially interrupted bands or band only present on T5) ..... 39
- 39(38). T6 sparsely striate-punctate, with large areas distinctly glossy, distal margin angled laterally (Fig. 131); T1–T5 each with medially interrupted bands; T2–T3 laterally with large, sparsely punctate area (Chile: Atacama) ..... *Anthidium atacamense* sp. nov.



- T6 coarsely and densely striate-punctate, punctures nearly contiguous, weakly shiny, distal margin not angled laterally (Fig. 179); T1–T4 without bands, sometimes with reduced lateral spot on T1 and two median spots on T4; T5 with broken or notched median band; T2–T3 densely punctate throughout (Peru, Bolivia, and Chile).....*Anthidium nigerrimum*
- 40(35). Depressed marginal zones of T2–T5 largely impunctate medially, distinctly smooth and shiny (Fig. 25).....*Anthidium danunciae* sp. nov.
- Depressed marginal zones of T2–T5 not largely impunctate medially, densely or sparsely punctate, integument weakly shiny between punctures.....41
- 41(40). T6 narrowed apically, disc strongly protuberant basomedially, preapically concave, lateral spine long and acute, surpassing distal margin or nearly so, distance between lateral spines approximately one-third width of segment (Fig. 140).....*Anthidium chubuti*
- T6 not narrowed apically, not strongly protuberant basally, flat or gently convex, lateral spine short, reduced, or absent, distance between lateral spines approximately one-half or more width of segment (e.g. Figs 148, 196, 206).....42
- 42(41). Clypeus distinctly convex, distal margin thick, not broader medially, non-tuberculate (Fig. 68); axilla and scutellum with yellow.....*Anthidium danieli*
- Clypeus weakly convex, distal margin variable, thin or thick, sometimes tuberculate (e.g. Figs 6, 70); axilla and scutellum black, without yellow.....43
- 43(42). Clypeal margin thin (Figs 6D, 89), projected as a flat rim, as seen in profile; depressed apical rim of T6 restricted to median one-third or less width of distal margin (Figs 169, 206).....44
- Clypeal margin thicker, swollen (e.g. Figs 6A,B, 70), not projected as a flat rim, as seen in profile; depressed apical rim of T6 projecting about 0.4× or more width of distal margin (Figs 30, 130, 150, 160, 196).....45
- 44(43). T6 truncate, without distinct lateral spine (Fig. 206); tegula dark brown to black; wings dark brown with weak blue and violet reflections.....*Anthidium weyrauchi*
- T6 not distinctly truncate, with small but distinct lateral spine (Fig. 169); tegula ferruginous; wings translucent brownish, without distinct blue and violet reflections.....*Anthidium luizae*
- 45(43). Hind tibia on outer surface with hairs relatively long, not spiculate; outer surface of hind basitarsus with hairs about the same length and thickness as those on anterior margin.....46
- Hind tibia on outer surface with hairs very short, spiculate; outer surface of hind basitarsus with hairs distinctly shorter and thicker than those on anterior margin.....49
- 46(45). Terga finely lineolate, dull to weakly shiny; T6 with distal margin somewhat truncate, depressed apical rim rounded, not projected as a rectangular band (Fig. 160); scopa pale (rarely brown); clypeal pubescence pale; smaller bees (8.4–9.5 mm).....*Anthidium gayi* (in part)
- Terga usually smooth and shiny, somewhat glossy; T6 with distal margin convex, not truncate, depressed apical rim projected as a rectangular band (Fig. 196); scopa black; clypeal pubescence dark; bees usually large (9–13 mm).....47
- 47(46). Scutum and scutellum distinctly smooth and shiny between dense but not contiguous punctures; labrum with preapical projections reduced, barely indicated by elevated border on the lateral margin of the furrow; vertex with broad maculated band; central and southern Argentina and southern Chile.....*Anthidium sparsipunctatum* sp. nov.
- Scutum and scutellum with contiguous punctures, dull or weakly shiny; labrum with preapical projections distinct, small to large; vertex with oval to round maculated spot behind compound eye; Bolivia, northern Chile, and north and central Argentina.....48
- 48(47). Labrum with preapical projections large, curved upwards; head and mesosoma mainly covered with ferruginous hairs; T3 usually with broadly interrupted band, gap in band about as long as length of lateral maculae or longer; central Chile.....*Anthidium adriani*
- Labrum with preapical projections small or reduced, indicated by elevated border on lateral margin of furrow; head and mesosoma with mostly black, grey, or pale hairs, not predominantly ferruginous; T3 usually with narrowly interrupted band, gap in band much less than length of lateral maculae; Bolivia, Argentina, and northern Chile.....*Anthidium rubripes*
- 49(45). Clypeal margin gently concave, not broad and flattened medially (Fig. 130) (Chile – Atacama; margin straight in specimens from Argentina – Jujuy).....*Anthidium anurospilum*
- Clypeal margin distinctly broad and flattened medially (Figs 70, 94).....50
- 50(49). T6 with rectangular depressed apical rim across more than median half of distal margin (Fig. 30); length of galea much shorter than eye length.....*Anthidium mapuche* sp. nov.
- T6 with semicircular or triangular depressed apical rim restricted to median half or less of distal margin (Fig. 150); length of galea nearly equal to length of eye.....*Anthidium decaspilum*

KEY TO THE SOUTH AMERICAN SPECIES OF *ANTHIDIUM* (MALES)

Specimens should be relaxed to uncurl their metasoma for viewing S4 (for hairs on distal margin) and S6–S8 (for shape). Unless otherwise indicated, bands or spots refer to yellow or cream maculations. Additional characters that are not unique but are useful in the identification of some species are indicated in parentheses. The following species appear twice in the key because of the variation in diagnostic characters. In *A. alsinai*, *A. cuzcoense*, and *A. friesei* the tibial carina is sometimes weak or absent; in *A. adriani*, *A. danunciae* sp. nov., *A. mapuche* sp. nov., *A. rubripes*, and *A. sparsipunctatum* sp. nov. the lateral lobe of T7 varies in width and shape; in *A. decaspilum* the apical brush of S4 varies in width (see species account). The males of the following six species are unknown: *A. isabelae*, *A. larocai*, *A. luizae*, *A. masunariae*, *A. neffi* sp. nov., and *A. tarsoi*.

1. Hind tibia with distinct longitudinal carina on anterior margin (as in Fig. 18).....2
- Hind tibia without longitudinal carina on anterior margin.....18
- 2(1). T7 with submedian spine or projection (e.g. Figs 37, 280).....3
- T7 without submedian projection (e.g. Figs 208, 214).....6
- 3(2). T7 with submedian projection longer than lateral spinose projection (Fig. 280); S6 with distal margin sinuous (Fig. 407).....*Anthidium vigintiduopunctatum*
- T7 with submedian projection shorter than spiniform or digitiform lateral projection (e.g. Figs 37, 251); S6 with distal margin not sinuous, straight (Fig. 368), or strongly medially projected (Fig. 371).....4
- 4(3). T6 with broad, obliquely truncate lateral projection; lateral lobe of T7 digitiform (Fig. 245); distal margin of S6 with broad, parallel-sided, apically bifid median lobe (Fig. 371).....*Anthidium latum*
- T6 and T7 with spiniform lateral projections (e.g. Fig. 37); S6 with distal margin straight or nearly straight, gently concave medially (e.g. Fig. 368).....5
- 5(4). T2 and T3 with distal margins narrow ( $\leq 1 \times$  PW); T6 with blunt lateral spine, stouter than submedian spine of T7; T7 without median spine, with stout lateral lobe, apically much wider than submedian spine (Fig. 37); integument of ventral surface of mesepisternum with scattered papillae among normal hairs.....*Anthidium insignissimum*
- T2 and T3 with distal margins broader, about one-quarter of depressed marginal zones; T6 with slender and pointed lateral spine, apically about as wide as submedian spine of T7; T7 with reduced median spine, barely indicated by tubercle, with slender lateral lobe, apically about as wide as submedian spine (Fig. 251); ventral surface of mesepisternum not papillate, densely covered by short, stout, simple, ferruginous to dark-brown hairs, as on metepisternum and hind coxa ventrally.....*Anthidium meloi* sp. nov.
- 6(2). Frons with integument largely visible among hairs (as in Figure 5E), often dull, coarsely and sparsely punctate ( $1-2 \times$  PW); S6 with median emargination on distal margin (Fig. 333).....7
- Frons with integument often obscured by hairs, smooth and shiny between nearly contiguous punctures; S6 with distal margin medially projected (e.g. Fig. 399), broadly rounded (Fig. 366), or sinuous (e.g. Fig. 355).....11
- 7(6). T7 with lateral lobe spiniform, about as wide as median spine (Fig. 208); S8 with truncate apical process in profile; wing veins, tegula and legs black.....*Anthidium andinum*
- T7 with lateral lobe not spiniform, parallel-sided, with apex somewhat obliquely truncate, much wider than median spine (Fig. 207); S8 with rounded apical process in profile; wing veins basally, tegula, apices of femora, tibiae, and tarsi ferruginous.....8
- 8(7). Frons with punctures nearly contiguous (Fig. 5B).....*Anthidium kolla* sp. nov.
- Frons with sparse punctures ( $1-2 \times$  PW).....9
- 9(8). T7 with lateral lobe elongate, longer than broad, median spine short, not reaching apex of lateral lobe (Fig. 207); Peru: Puno.....*Anthidium alsinai* (in part)
- T7 with lateral lobe short, at most about as long as broad, median spine long, reaching apex of lateral lobe; Argentina: Salta.....10
- 10(9). S6 with shallow median emargination on distal margin, about  $5 \times$  broader than deep; modified integument on frons (i.e. with coarse, large, spaced punctures on shagreened integument), not or scarcely extending laterally beyond lateral ocellus (Fig. 5C); sterna with black hairs, including apical brush of S4.....*Anthidium cafayate* sp. nov.
- S6 with deeper median emargination on distal margin, about  $3 \times$  broader than deep; modified integument on frons extending laterally well beyond lateral ocellus (Fig. 5D); sterna with whitish hairs laterally (best seen in profile), apical brush of S4 reddish brown.....*Anthidium calchaqui* sp. nov.
- 11(9). Lateral lobe of T7 broad and rounded,  $\geq 1.2 \times$  broader than distance between its inner margin and median spine (e.g. Figs 255, 272).....12
- Lateral lobe of T7 narrowly rounded (e.g. Fig. 261), spiniform (e.g. Fig. 253) or digitiform (e.g. Fig. 274), narrower than distance between its inner margin and median spine.....14

- 12(11). Lateral lobe of T7 longer than broad, apically rounded, about 1.2× broader than distance between its inner margin and median spine, outer margin gently convex to nearly straight (Fig. 255); S8 with short and pointed apical process (Fig. 535); T4–T6 each with four large spots, sometimes weakly joined laterally.....*Anthidium paitense*
- Lateral lobe of T7 about as long as broad, broadly rounded,  $\geq 2.0\times$  broader than distance between its inner margin and median spine, outer margin strongly convex (Figs 248, 272); S8 with distinctly broad apical process (Figs 527, 553); T4–T6 with entire bands (Colombia, Venezuela, northern Brazil).....13
- 13(12). S6 with small, ventrally oriented median spine on distal margin (Fig. 399) (Colombia, Venezuela, Suriname).....*Anthidium sanguinicaudum*
- S6 without small spine on distal margin (Fig. 374) (French Guiana; Brazil – Roraima, Surumu).....*Anthidium macushi* sp. nov.
- 14(11). Sides of T2–T5 strongly protuberant, densely covered by tufts of long yellowish hairs; T1–T6 with bands broadly interrupted medially, progressively closer towards apical terga, forming distinctive black, broad, V-shaped area across terga (Fig. 34) (introduced).....*Anthidium manicatum*
- Sides of T2–T5 not protuberant, without tufts of hairs; T1–T6 with medially interrupted bands forming different patterns or each with four large spots.....15
- 15(14). Lateral lobe of T7 spiniform (Figs 230, 274).....16
- Lateral lobe of T7 not spiniform (Figs 225, 237).....17
- 16(15). T7 with median spine present, small (Fig. 230); S4 with distal margin straight or nearly straight, apical brush of hairs indistinct, white; S6 with sinuous distal margin (Fig. 355).....*Anthidium deceptum*
- T7 with median spine reduced to tubercle (Fig. 274); S4 with distinct reddish brown apical brush of hairs on medially projected distal margin (Fig. 327); S6 with distal margin medially projected, apex ventrally bent (Fig. 401).....*Anthidium sertanicola*
- 17(15). S6 with distinct discal lateral carina anteriorly curved, as seen in profile, distal margin straight (Fig. 350); T1–T5 each with four spots; forewing with dark-brown veins.....*Anthidium cuzcoense* (in part)
- S6 without lateral carina, with small, blunt lateral spine, distal margin medially projected into narrowly truncate median lobe (Fig. 362); T1–T5 with medially interrupted bands; forewing with ferruginous veins basally, dark brown distally.....*Anthidium friesei* (in part)
- 18(1). Penis valve greatly elongate, extending anteriorly over S6 to apical brush of S4, clearly visible without dissection (as in Fig. 38).....*Anthidium edwini*
- Penis valve not greatly elongate, not extending anteriorly over S6, barely or not visible without dissection.....19
- 19(18). T7 narrowed apically, lateral lobes close together beneath median spine (Figs 210, 235, 253).....20
- T7 not narrowed apically, lateral lobes separated, not beneath median spine (e.g. Figs 214, 229).....22
- 20(19). S4 with distinct apical brush of black hairs (Fig. 302) (Chile: Coquimbo).....*Anthidium espinosai*
- S4 without apical brush.....21
- 21(20). S6 with thick reflexed distal margin, except medially (Fig. 379); T1–T4 black, sometimes with reduced lateral spot on T1, T5 with broken or notched median band; T2–T3 densely punctate throughout.....*Anthidium nigerrimum*
- S6 with thinner reflexed distal edge on entire margin (Fig. 335); T1–T5 with medially interrupted bands; T2–T3 laterally with large, sparsely punctate area.....*Anthidium atacamense* sp. nov.
- 22(19). S4 with distinct, broad (greater or equal to one-third of sternal width) brush of stout black hairs on distal margin (e.g. Figs 289, 297).....23
- S4 without apical brush of stout black hairs, or, if present, small (less than or equal to one-quarter of sternal width) or yellowish, or reddish brown (e.g. Figs 293, 332).....27
- 23(22). Lateral lobe of T7 broad, subtriangular (Fig. 229).....*Anthidium decaspilum*
- Lateral lobe of T7 spiniform or digitiform, not subtriangular (Figs 209, 214, 219).....24
- 24(23). Lateral lobe of T7 spiniform, about the same width and length as lateral spine of T6 and median spine of T7 (Fig. 219); S3 with distinct apical brush of black hairs, as on S4 (Fig. 289).....*Anthidium chubuti*
- Lateral lobe of T7 not spiniform, much longer and broader than lateral spine of T6 and median spine of T7 (Figs 209, 214); S3 unmodified, without apical brush of black hairs.....25
- 25(24). S6 with long lateral lobe, median lobe with anteriorly curved apex (Fig. 334); apical brush of S4 with short, sparse hairs (Fig. 283); lateral lobe of T7, as measured at base, about as wide as distance between its inner margin and median spine, distinctly diverging apically (Fig. 209).....*Anthidium anurospilum*
- S6 without distinct lateral and median lobes (Fig. 339); apical brush of S4 with longer, denser hairs (Fig. 286); lateral lobe of T7 digitiform, not diverging apically, narrower than distance between its inner margin and median (Fig. 214).....26
- 26(25). S6 with small lateral spine, distal margin medially concave; lateral lobe of T7 with apex slightly curved medially; antenna largely ferruginous.....*Anthidium aymara*
- S6 laterally rounded, without small lateral spine, medially straight or nearly straight (Fig. 339); apical brush of S4 with longer, denser hairs (Fig. 286); lateral lobe of T7 digitiform with apex straight, not medially curved (Fig. 214); antenna mostly dark brown to black.....*Anthidium adelphum* sp. nov.



- 27(22). S6 with median notch or emargination on distal margin (e.g. Fig. 388).....28  
 — S6 with distal margin straight (e.g. Fig. 353), sinuous (e.g. Fig. 398), or medially projected (e.g. Fig. 394)....  
 .....34
- 28(27). Discs of T6 and T7 largely impunctate laterally; T1 and T2 (as on T3–T6) with complete or narrowly interrupted bands (gap between bands shorter than half length of lateral band).....29  
 — Discs of T6 and T7 punctate throughout, without large impunctate areas; T1 and T2 (as on T3–T6) each with four bands or with broadly interrupted band, never with complete band.....31
- 29(25). S5 gently concave on median 0.7× distal margin; S6 with short and blunt lateral spine, median emargination more than three times broader than deep, extending across a little less than median half (0.4×) of distal margin, as measured between lateral lobes (Fig. 405).....*Anthidium toro*  
 — S5 gently concave on median one-third of distal margin; S6 with long lateral lobe, median emargination narrower, about as broad as deep, occupying about median one-seventh to one-fifth of distal margin, as measured between lateral lobes (Figs 388, 403).....30
- 30(29). S6 with spinose lateral lobe (Fig. 388) (Peru).....*Anthidium peruvianum*  
 — S6 with spatulate lateral lobe (Fig. 403) (Chile).....*Anthidium spatulatum* sp. nov.
- 31(28). Frons dull, with coarse and sparse punctures (1–2× PW), integument largely visible among hairs (as in Fig. 5B, C); S4 with small (about one-eighth of sternal width), often inconspicuous apical brush of black hairs; lateral lobe of T7 rectangular, parallel-sided, apex somewhat obliquely truncate (Fig. 207).....*Anthidium alsinai* (in part)  
 — Frons with punctures nearly contiguous, integument smooth and shiny between punctures, often obscured by hairs; S4 without apical brush of hairs; lateral lobe of T7 not parallel-sided, outer margin gently to strongly curved apically (Figs 238, 288), except in *A. rozeni* (Fig. 270).....32
- 32(31). S6 with shallow median emargination on distal margin, about 5× broader than deep (Fig. 363); legs dark brown to black.....*Anthidium funereum*  
 — S6 with deeper median emargination on distal margin, 1–2× broader than deep (Fig. 397, 409); legs ferruginous, except for coxae and femora basally.....33
- 33(32). T7 with lateral lobe parallel-sided, apically rounded (Fig. 270); S8 with distinct bifid apical process (Fig. 551); T1–T4 with gap between bands shorter than length of each lateral band; wings translucent brownish, without distinct blue and violet reflections.....*Anthidium rozeni*  
 — T7 with lateral lobe not parallel-sided, gently curved apically (Fig. 282); S8 with apical process weakly bifid, nearly simple (Fig. 563); T1–T4 with gap between bands much greater than length of each lateral band; wings dark brown with weak blue and violet reflections.....*Anthidium weyrauchi*
- 34(27). Lateral lobe of T7 spiniform (e.g. Fig. 218), rounded (e.g. Fig. 224), subrectangular, subquadrate (e.g. Fig. 281), or elongate with truncate or obliquely truncate apex (e.g. Fig. 267), not triangular or subtriangular.....35  
 — Lateral lobe of T7 triangular or subtriangular (Figs 228, 239, 250, 271).....48
- 35(34). Lateral lobe of T7, as measured at base, 1.5–2.0× as broad as distance between its inner margin and median spine (e.g. Figs 224, 267).....36  
 — Lateral lobe of T7 about as wide as, or narrower than, distance between its inner margin and median spine (e.g. Figs 218, 241).....43
- 36(35). Lateral lobe of T7 distinctly long, more than half (–0.7×) the maximum width of the tergum at base (Fig. 267); S6 with long, acute lateral lobe, median lobe nearly parallel-sided, apically concave (Fig. 394); large bees, ~15 mm in body length.....*Anthidium rafaelli*  
 — Lateral lobe of T7 much shorter, less than half the maximum width of tergum (e.g. Figs 224, 228); S6 with small triangular or spinose lateral lobe, median lobe absent or triangular (e.g. Figs 349, 353).....37
- 37(36). S4 with broad apical brush on distal margin, about one-quarter of sternal width (Fig. 293); S6 with acute lateral and median projections (Fig. 349); basitarsi yellow.....*Anthidium colliguayanum*  
 — S4 without apical brush or with very small brush, about one-fifth or less of sternal width (e.g. Figs 296, 324); S6 laterally with obtuse angle or gently rounded, distal margin straight or sinuous (Figs 353, 398); basitarsi ferruginous.....38
- 38(37). T2–T5 with depressed marginal zones largely impunctate medially, with only some scattered punctures laterally, distinctly smooth and shiny (Fig. 25); S6 with distal margin straight or nearly straight (Fig. 353).....*Anthidium danunciae* sp. nov. (in part)  
 — T2–T5 with depressed marginal zones sparsely punctate throughout (1–3× PW); S6 with sinuous distal margin or with small median projection (Figs 44, 398, 408).....39
- 39(38). Lateral lobe of T7 subquadrate (Fig. 281); S4 with reddish brown apical brush of hairs (Fig. 332) (T2–T5 each with four spots).....*Anthidium vigintipunctatum*  
 — Lateral lobe of T7 subtriangular (Fig. 250), obliquely truncate to narrowly rounded (Fig. 271); S4 with black apical brush of hairs (Figs 311, 324) (T2–T5 with medially interrupted bands).....40
- 40(39). S4 with apical brush occupying one-fifth of sternal width (Fig. 311); S6 with distal margin medially projecting (Fig. 44); S8 with short, apically truncate, densely pilose apical process (Fig. 529).....*Anthidium mapuche* sp. nov. (in part)

- S4 with smaller apical brush, about one-tenth of sternal width (Fig. 324); S6 distal margin not medially projecting, sinuous, straight, or nearly straight (Fig. 398); S8 with long, pointed, not densely pilose apical process (Fig. 552).....41
- 41(40). Head and mesosoma mainly covered with ferruginous hairs; T1–T3 usually with broadly interrupted bands, gap between bands about as long as length of lateral band or longer; central Chile, regions V–VIII.....*Anthidium adriani* (in part)
- Head and mesosoma with mostly black, grey, or pale hairs, not predominantly ferruginous; T1–T3 usually with narrowly interrupted bands, gap between bands much less than length of lateral band; Bolivia, Argentina, and regions I, II, and XI of Chile.....42
- 42(41). Scutum and scutellum distinctly smooth and shiny between scattered, not contiguous punctures; vertex often with broad band; S6 with distal margin medially sinuous; lateral lobe of T7 subtriangular; bees usually large (10–15 mm in body length); central and southern Argentina and southern Chile (region XI).....*Anthidium sparsipunctatum* sp. nov. (in part)
- Scutum and scutellum with contiguous punctures, dull or weakly shiny; vertex usually with oval to rounded spot behind compound eye; S6 with distal margin straight or nearly straight; lateral lobe of T7 subrectangular; bees usually smaller (8–13 mm in body length); Bolivia, northern Chile (regions I and II), and north and central Argentina.....*Anthidium rubripes* (in part)
- 43(35). Lateral lobe of T7 spiniform (Figs 218, 241); apical brush of S4 absent.....44
- Lateral lobe of T7 not spiniform (e.g. Figs 225, 237); apical brush of S4 present, small, reddish brown or black.....45
- 44(43). T7 with median spine distinctly short and blunt, at least about as wide as apex of lateral lobe (Fig. 218); S6 sharply angled laterally, distal margin broadly rounded, somewhat truncate apically (Fig. 343); S8 with angled apicolateral margins, apical process truncate, not bifid (Fig. 496).....*Anthidium chilense*
- T7 with median spine longer and more slender, about as long as lateral lobe, narrower than apical width of lateral lobe (Fig. 241); S6 with blunt, posteriorly directed lateral spine, as seen in profile, distal margin gently convex with small median projection (Fig. 366); S8 without angled apicolateral margins (apicolateral margins distinctly dorsally bent, as seen in profile), apical process weakly bifid (Fig. 519).....*Anthidium igori*
- 45(43). Distal margins of T3–T5 broadly impunctate submedially, at least about as wide as width of depressed, punctate marginal zone; tibiae dark brown with yellow markings, basitarsi yellow.....46
- Distal margins of T3–T5 not broadly impunctate submedially, about half or less the width of depressed, punctate marginal zone; tibiae and basitarsi ferruginous, rarely with pale or cream markings.....47
- 46(45). S6 with distinct discal carina anteriorly curved as seen in profile, distal margin straight or nearly straight (Fig. 350); forewing with dark-brown veins; T2–T5 each with four spots.....*Anthidium cuzcoense* (in part)
- S6 without lateral carina, with small, blunt lateral spine, distal margin projected into narrowly truncate median lobe (Fig. 362); forewing with ferruginous veins basally, dark brown distally; T2–T5 with medially interrupted bands.....*Anthidium friesei* (in part)
- 47(45). Lateral lobe of T7 with obliquely truncate apex, thus each lobe of T7 appearing to diverge apically from midline (Fig. 227); S6 with short, broad lateral angle or spine, distal margin medially projected, somewhat apically truncate (Fig. 352); genitalia with penis valve deeply bifid apically, with distinct median lobe.....*Anthidium danieli*
- Lateral lobe of T7 with apex rounded or nearly so, not obliquely truncate, parallel with midline (Fig. 261); S6 without short and broad lateral angle or spine, distal margin sinuous (Fig. 387); genitalia with penis valve simple, not apically bifid.....*Anthidium penai*
- 48(34). Depressed marginal zones of T2–T5 largely impunctate medially, distinctly smooth and shiny (Fig. 25).....*Anthidium danunciae* sp. nov. (in part)
- Depressed marginal zones of T2–T5 densely or sparsely punctate medially, integument usually duller between punctures.....49
- 49(48). S6 with distal margin medially projecting, not straight or sinuous (Fig. 44).....*Anthidium mapuche* sp. nov. (in part)
- S6 with distal margin sinuous, straight, or nearly straight (Figs 364, 398).....50
- 50(49). S4 with rather sparse apical brush of hairs on median one-fifth of distal margin (Fig. 304); S6 distal margin straight or nearly straight (Fig. 364); T7 with acutely triangular lateral lobe; sternal hairs brownish to pale (better seen in profile); small bees, body length usually less than 12 mm (T2 and T3 with thin, broadly separated lateral bands, gap between bands usually 1.5–2.0× wider than width of lateral band).....*Anthidium gayi*
- S4 with smaller, denser apical brush of hairs on median one-tenth of distal margin (Fig. 324); S6 with distal margin sinuous to nearly straight (Fig. 398); T7 with lateral lobe variable in shape, triangular or subtriangular to somewhat rectangular, apically acute or rounded, often obtusely angled on the inner margin; sternal hairs dark brown to black; much larger bees, body length often more than 12 mm (T2 and T3 with thicker and closer lateral bands, gap between bands about as wide or narrower than width of lateral band).....51

- 51(50). Head and mesosoma with abundant ferruginous hairs; T1–T3 usually with broadly interrupted bands, gap between bands about as long as length of lateral band or longer; central Chile, regions V–VIII.....*Anthidium adriani*
- Head and mesosoma with mostly black, grey, or pale hairs, not predominantly ferruginous; T1–T3 usually with narrowly interrupted bands, gap between bands much less than length of lateral band; Bolivia, Argentina, and regions I, II, and XI of Chile.....52
- 52(51). Scutum and scutellum with punctures not contiguous, distinctly smooth and shiny between punctures; vertex often with broad band; S6 with distal margin medially sinuous; bees usually large (10–15 mm in body length); central and southern Argentina and southern Chile (region XI).....*Anthidium sparsipunctatum* sp. nov. (in part)
- Scutum and scutellum with contiguous punctures, dull; vertex usually with oval to rounded spot behind compound eye; S6 with distal margin straight or nearly straight; bees usually smaller (8–13 mm in body length); Bolivia, northern Chile (regions I and II), and north and central Argentina.....*Anthidium rubripes* (in part)

## SPECIES ACCOUNTS

Note that features listed in the diagnoses are combinations of characters unique to each species or a group of closely related species. To avoid redundancy in the descriptions, the usual secondary sexual characters of the male (e.g. 11 antennal segments) and those that are similar to the female are omitted. The following common characters are also omitted in the descriptions: male clypeus gently convex, usually more convex and finely punctate than in the female; female clypeus with unmodified hairs (i.e. minutely branched, as on remaining areas of face); and mesoscutum and mesoscutellum with strong, contiguous punctures (as in Fig. 16).

*ANTHIDIUM ADELPHUM* SP. NOV.

FEMALE, FIGS 5A, 135; MALE, FIGS 214, 286, 339, 416, 492

*Diagnosis:* Both sexes of this species are similar to those of *A. aymara* in the following combination of characters: body colour (tegula, most of legs and base of wings ferruginous, and T1–T5 with broadly interrupted yellow or cream marks); female T6 convex in profile, medially depressed, and laterally projecting into a distinct spine; male T7 with elongate lateral lobe; and male S4 with broad, long-haired apical brush. The female can be separated from *A. aymara* by the clypeus, which has a thinner apical margin (Fig. 5A), and T6, which has a black lateral spine and a nearly straight, not medially projecting, distal margin (Fig. 135); the male can be recognized by the T7, which has a lateral lobe with a parallel-sided apex (Fig. 214), and S6, which is laterally rounded and straight, or nearly straight, on distal margin (Fig. 339). In *A. aymara*, the female has a clypeus with much thicker margin (Fig. 55), and T6 has a yellowish, translucent lateral spine and a medially projecting distal margin; in the male, the apex of the lateral lobe of T7 is slightly curved medially, and S6

has a small, distinct lateral spine and median concavity on distal margin. In addition, both sexes of *A. adelphum* sp. nov. can be separated from *A. aymara* by the slightly smaller body size, antenna dark brown to black, vertex and dorsum of mesosoma with darker pubescence, and T1–T5 with narrower integumental bands.

*Description (paratypes in parentheses): Female.* Body length 12.8 mm (9.2–12.8); forewing length 9.1 mm (7.1–9.1). *Structure.* Clypeus weakly convex, projected about 0.5× width of compound eye in profile, distal margin thin, non-tuberculate between two lateral tubercles (Fig. 5A); mandible with six teeth (four in one paratype, seven in others); labrum without basal protuberances, preapical projections indicated by elevated border on lateral margin of furrow; F1 about twice as long as broad, slightly longer than combined lengths of F2 and F3. Tibial carina absent. T6 convex in profile, distinctly depressed medially, lateral spine distinct, curved, distal margin straight or nearly straight, not medially projecting (with small sublateral projection in two paratypes), median emargination reduced or absent (Fig. 135). *Coloration.* Dark brown to black, except yellow maculations as follows: outer surface of mandible basally, rounded spot on inferior paraocular area (entirely yellow in some paratypes), apical third of clypeus, except on margin (apical two-thirds yellow in some paratypes), rounded to oval spot laterally on vertex, medially interrupted bands on T1–T5, bands weakly emarginate laterally on posterior margin of basal three terga; ferruginous on tegula and legs, except dark-brown coxae, trochanters, and bases of femora. Wings light orange basally, brownish distally; veins ferruginous basally, dark brown distally, including stigma. *Pubescence.* Whitish, except: ferruginous hairs on tarsi; brownish or greyish black, intermingled with whitish hairs on vertex, pronotal lobe, and dorsum of mesosoma; dark brown to black hairs on depressed marginal zones of



T1 and T2 (pale in some paratypes) and entire surface of remaining terga; metasomal scopa mostly light brown, pale laterally when seen in profile. Outer surface of fore and mid basitarsi sparsely covered with some pale tomentum, denser on fore basitarsus (integument visible among hairs). *Sculpturing*. Propodeal triangle weakly shiny, weakly imbricate. T1–T5 with weakly elevated discal areas, weakly shiny, weakly lineolate or imbricate, sparsely punctate (2–3× PW); depressed marginal zones slightly denser than on discs (1–2× PW); distal margins dull, not or little differentiated from rest of depressed marginal zone, occupying about one-quarter of punctate depressed marginal zone; T6 weakly shiny, weakly lineolate or imbricate, as on preceding terga (nearly smooth, shiny between punctures in some paratypes).

*Male*. Body length 12.3–15.4 mm; forewing length 9.5–11 mm. *Structure*. F1 1.9× longer than broad, shorter (0.8×) than combined lengths of F2 and F3. Lateral spine of T6 gently curved, about as long as median spine of T7; lateral lobe of T7 elongate, parallel-sided, nearly digitiform (Fig. 214); S4 with dense apical brush of long hairs on median half of concave distal margin (Fig. 286); S6, in ventral view, with basal margin biconvex, distal margin sinuous (Fig. 339); S7 hemisternite as in Figure 416; S8 with long, narrow apical process, curved in profile, basally broad, about half width of distal margin (Fig. 492). Genitalia: gonostylus robust, 3.0× longer than broad; volsella small, about one-third of gonostylar length, apically convex, dorsally projecting into lobe or point; penis valve about as long as gonostylus, narrow, blade-like, apically pointed, dorsoapical patch of hairs absent, medial projection large, distinct. *Coloration*. As in female except clypeus and inferior paraocular area entirely yellow, T1 with lateral band sometimes reduced and T6 with small submedian spot. *Pubescence*. Sterna with whitish hairs. *Sculpturing*. Terga smoother, shinier than in female, particularly on T6.

*Holotype*: ♀, [CHILE], Codpaquilla, Tarapacá, 16-IX-1971, Peña col. (AMNH).

*Paratypes*: 29 females, 18 males. CHILE: Antofagasta, Antofagasta Prov., 1♂, Paposo, 16 Oct 1981, H. Burgos; El Loa Prov., 1♂, Aguas Blancas, 5–7 km E, SE San Pedro de Atacama, 7 Apr 2004, L. Packer; 1♂, Cuesta de Diablo, 4 km N of Puritama, N of San Pedro, 13 Oct 2001, L. Packer, Fraser; 1♀, San Pedro, 29 km E, 11 Oct 2001, L. Packer, Fraser; 1♂, Talabre, 6 Dec 1992, E. Chiappa; 1♂, Talabre, 6 Nov 1992, H. Toro; 2♂, Talabre Viejo, 3 km E, SE of San Pedro, 25 Mar 2000, L. Packer; 1♀, Talabre Viejo, 3 km E, SE of San Pedro, 28 Mar 2000, L. Packer; 1♂, 2♀, Talabre Viejo, 3 km E; SE of San Pedro, 25 Mar 2000, L.

Packer; Arica y Parinacota, Parinacota Prov., 1♀, Codpaquilla, 16 Apr 1971, H. Toro; 6♀, Codpaquilla, 5 Aug 1972, H. Toro; 1♀, Codpaquilla, 22 Apr 1971, W. Sielfeld; 1♀, Codpaquilla, 28 Jan 1972, H. Toro; 1♂, 1♀, Codpaquilla, 16 Sep 1971, L. Pena; 1♀, Codpaquilla, 16 Sep 1971, H. Toro; 5♂, 7♀, Copaquilla, 1 Sep 1989, C. Porter; Copaquilla, c. Zapahuira, 22 Apr 1999, C. Porter; 1♀, Puente Murmuntani, SE of Zapahuira, 13 Apr 2004, L. Packer; 1♂, Putre, E, 14 Apr 2004, L. Packer; 4♀, Socoroma, 30 Aug 1989, C. Porter; 1♀, 1♂, Zapahuira, 28 Jan 1972, *Phacelia*, H. Toro; 1♂, Zapahuira, 29 Sep 1966, M.E. Irwin; 1♂, Zapahuire, 3 km E of, 29 Sep 1966, M.E. Irwin. PERU: Arequipa, 1♂, Neochachani, SW slope, 3 Nov 1963, Fabaceae, R.M. Straw. (AMNH, BBSL, CAS, FSCA, USNM).

*Distribution*: Northern CHILE: Arica and Parinacota, Antofagasta; southern PERU: Arequipa (2800–4400 m a.s.l.). Recorded from the Central Andean dry puna, and Sechura and Atacama desert ecoregions.

*Phenology*: August–January, March, April; majority of records (52%) in August and September.

*Floral records*: BORAGINACEAE: *Phacelia* sp.

*Etymology*: The specific epithet is derived from the Greek ‘adelph’ meaning ‘sister to’, in reference to the sister relationship to *A. aymara*.

*Comments*: Toro & Rodríguez (1998) examined specimens of this new species when they described *A. aymara*, commenting on their colour differences and regarding them as colour variants of that species. Further analysis indicates they are a distinct species reliably distinguished by the shape of the clypeal margin and T6 of the female, as well as the shape of T7 and S6 of the male. Interestingly, the illustrations that accompanied the description of *A. aymara*, except for the habitus figures, are from specimens of *A. adelphum* sp. nov., not from any of the types of *A. aymara*.

#### **ANTHIDIUM ADRIANI RUIZ, 1935 STAT. NOV.**

FEMALE, FIG. 6A

*Anthidium adriani* Ruiz, 1935: 277 (Syntypes: CSPN; ♂, ♀, Cordillera de Santiago, Chile; not examined).

*Diagnosis*: Both sexes of this species are most similar to those of *A. rubripes* and *A. sparsipunctatum* sp. nov., in the absence of a tibial carina, coloration pattern (i.e. antenna, tegula, legs, and base of wings ferruginous, with interrupted yellow or cream bands on T1–T4), female T6 with a depressed apical rim

projecting in a broad curve (Fig. 196), and male T7 with broad, obliquely truncate lobe, and male sterna with dark hair. They can be easily separated from *A. rubripes* and *A. sparsipunctatum* sp. nov. by the female labrum with large preapical projections, the head and mesosoma mainly covered with ferruginous hairs, and T1–T3 usually with broadly interrupted bands (gap between bands about as great as length of lateral band or longer). Additionally, *A. adriani* seems to be restricted to central Chile (regions V–VIII), not occurring in sympatry with *A. rubripes* and *A. sparsipunctatum* sp. nov.

**Description: Female.** Body length 11.5–14.0 mm; forewing length 8.9–9.5 mm. **Structure.** Clypeus weakly convex, projected about 0.3× width of compound eye in profile, distal margin thick, distinctly broad medially (Fig. 6A); mandible with six or seven teeth; labrum without basal protuberances, preapical projections large, distinctly curved upwards; F1 about twice as long as broad, shorter (~0.9×) than combined lengths of F2 and F3. Tibial carina absent. T6 gently convex basally, with small, acute lateral spine, preapical carina minutely crenulate, depressed apical rim on about half of gently convex distal margin, projecting as a rectangular rim. **Coloration.** Black, except as follows: ferruginous on antenna (darker on distal flagellomeres), pronotal lobe, tegula, most of femora, and remaining segments of legs; cream or yellow as follows: oval spot laterally on vertex, and T1–T5 with medially interrupted bands, gap between bands at least as long as length of lateral band, or longer, bands closest on apical terga. Wings light orange basally, brownish distally; veins ferruginous basally, including stigma, dark brown distally. **Pubescence.** Head and mesosoma predominantly with yellowish to ferruginous hairs, except dark-brown to black hairs on coxae, trochanters, and bases of femora (sometimes darkened on head and mesepisternum); metasoma with dark-brown to black hairs, except sometimes by whitish hairs on discs of T1 and T2. Fore basitarsus with sparse fringe of long hairs ( $\geq 2\times$  basitarsal width) along posterior margin. **Sculpturing.** Propodeal triangle weakly shiny, finely lineolate to imbricate. T1–T5 with weakly elevated discal areas, glossy, smooth to weakly imbricate, shiny between sparse punctures ( $2\text{--}4\times$  PW); depressed marginal zones more densely punctate than on discs ( $1\text{--}2\times$  PW); distal margins smooth, shiny, narrow ( $1\text{--}3\times$  PW).

**Male.** Body length 12.3–17.0 mm; forewing length 9.4–11.1 mm. **Structure.** Labrum without preapical projections; F1 1.7× longer than broad, shorter ( $0.8\times$ ) than combined lengths of F2 and F3. Lateral spine of T6 straight or nearly straight, about as long as median spine of T7; lateral lobe of T7 triangular,

sometimes angled on inner margin, about 1.3× wider than distance between inner margin and median spine; S4 with dense, black hair brush on median one-sixth of straight distal margin; S6, in ventral view, with gently convex to nearly straight basal margin, laterally with small, sharp, ventrally directed angle, distal margin sinuous; S7 hemisternite as in Figure 475; S8 with short, curved, simple apical process, basally broad, about one-third width of distal margin. **Genitalia:** gonostylus about three times longer than broad; volsella small, about one-third of gonostylar length, elongate, somewhat digitiform, ventrally curved in profile; penis valve about as long as gonostylus, long, apically narrow, pointed, blade-like, dorsoapical patch of hairs absent, medial projection large, distinct. **Coloration.** As in female, except lateral bands on T1–T5 more widely separated, and yellow or ivory on outer surface of mandible basally, clypeus, and inferior paraocular area. **Pubescence.** Head and mesosoma with paler hairs than in female. **Sculpturing.** Terga with distal margins broader than in female.

**Distribution:** CHILE: Valparaíso to Bío-Bío; ARGENTINA: 'N.-W. Patagonia 1000–3000 ft' (1000–1600 m a.s.l.). Found in Valdivian temperate forests ecoregion.

**Phenology:** November–February.

**Comments:** *Anthidium adriani* is resurrected from synonymy under *A. rubripes* (Urban, 2002); it is not only geographically separated, but is distinct morphologically, and is readily recognized as indicated in the key to species.

#### ANTHIDIUM ALSINAI URBAN, 2001

##### MALE, FIG. 207

*Anthidium alsinai* Urban, 2001b: 539 (holotype: DZUP; ♂, Puno, Peru).

**Diagnosis:** This species is only known from the male holotype. It resembles the Peruvian species *A. weyrauchi* in S6, with median emargination on the distal margin and legs ferruginous, contrasting with the largely black body; however, the supraclypeal area and frons are dull, and coarsely and sparsely ( $1\text{--}2\times$  PW) punctate, as in *A. andinum*, *A. kolla* sp. nov., *A. cafayate* sp. nov., and *A. calchaqui* sp. nov., the other known South American species with similar modifications on the face. It can be separated from these species by T7 with rectangular, parallel-sided lateral lobe obliquely truncate apex, and median spine short, not reaching the apex of the lateral lobe (Fig. 207). The lateral lobe of T7 is spiniform in

*A. andinum* (Fig. 208), broad and gently curved in *A. weyrauchi* (Fig. 282), and distinctly short in *A. cafayate* sp. nov. and *A. calchaqui* sp. nov. Also, in those species the median spine of T7 is longer, reaching the apex of the lateral lobe. It can be distinguished from *A. kolla* sp. nov. by the frons with sparser punctures (nearly contiguous in *A. kolla* sp. nov.).

**Description: Male.** Body length 11.2 mm; forewing length 10.3 mm. **Structure.** Mandible three-toothed, with upper interspace greater than lower interspace; labrum with low basal protuberances separated by about two times width of protuberance, preapical projections absent; F1 1.8× longer than broad, shorter (0.8×) than combined lengths of F2 and F3; supraclypeal area with small protuberance in middle, just above inferior tangent of antennal sockets. Tibial carina present, weak. Lateral spine of T6 gently curved, longer than median spine of T7; lateral lobe of T7 rectangular, parallel-sided, 1.8× longer than broad, about 1.5× broader than distance between inner margin and median spine, somewhat obliquely truncate apically (Fig. 207); S4 with distal margin straight or nearly straight, with sparse but distinguishable brush of black hairs (about one-eighth sternal width); S6 with lateral spine small, acute, lateroventrally oriented, distal margin with semicircular median emargination about twice as broad as deep; S7 hemisternite apically truncate; S8 with pointed apical process. Genitalia: penis valve with apex laterally compressed; other genitalic structures not visible. **Coloration.** Dark brown to black, except yellow maculations as follows: outer surface of mandible, inferior paraocular area, clypeus except pair of small black spots just above level of tentorial pits, rounded to oval spot laterally on vertex, T2–T4 with medially interrupted bands, closer on T4, and T5 with entire broad band, medially notched on anterior margin, laterally shallowly concave on posterior margin; ferruginous on: antenna (except scape and F8–F11 dark brown), tegula, apices of femora, and tibiae; tarsi yellowish. Wings light orange basally, brownish distally; veins ferruginous basally, dark-brown distally, including stigma. **Pubescence.** Black, except: whitish hairs on clypeus, inferior paraocular area, sides of scape, and ferruginous areas of legs; brownish hairs on bases of fore and middle tibiae. **Sculpturing.** Supraclypeal area and frons dull, with sparse (1–2× PW), coarse heterogeneous punctures (larger punctures about 2–3× as big as small ones), smaller punctures located just above supraclypeal area. Propodeal triangle dull, finely lineolate. T1–T5 with weakly elevated discal areas, shiny, nearly smooth; depressed marginal zones more densely punctate than on discs (1–2× PW), distal margins smooth, about one-third width of depressed marginal zone.

**Distribution:** PERU: Puno (3900 m a.s.l.). Recorded from Central Andean wet puna ecoregion.

**Phenology:** November.

**Comments:** This species was described from a single male collected in Puno, Peru. Because the face of *A. alsinai* is modified in the male, the unknown female of this species might have similar modifications as occurs in other *Anthidium* species. It is expected to run to *A. andinum* in the key to species.

#### ANTHIDIUM ANDINUM JÖRGENSEN, 1912

FEMALE, FIGS 49, 129; MALE, FIGS 46, 208, 333, 410

*Anthidium andinum* Jörgensen, 1912: 136 (holotype: MLP; ♂, Estación Blanco Encalada, Mendoza, Argentina; not examined).

**Diagnosis:** Both sexes of *A. andinum* have the supraclypeal area and frons flat, dull, coarsely and sparsely (1–2× PW) punctate. The clypeus is also flat and covered with simple, stiff, apically curly or hooked hairs in the female (Fig. 49). Similar modifications of the face are found in *A. chamelense* sp. nov., *A. maculosum*, *A. parkeri* sp. nov., and *A. rodriguezi* from North America, and in *A. alsinai*, *A. cafayate* sp. nov., *A. calchaqui* sp. nov., and *A. kolla* sp. nov. from South America. However, *A. andinum* differs from these North American species in the following characters: labrum with long and distinct preapical projections (as in Figs 12, 13); female clypeus with sinuous distal margin, sublaterally with distinct, obtuse projections (Fig. 49); and male S6 with distal margin medially emarginate (Fig. 333). In those species, the preapical labral projections are absent, the clypeal margin of the female is straight or nearly straight, without distinct obtuse sublateral projections (e.g. Fig. 58), and the distal margin of S6 is broadly rounded (Fig. 373) or projected into a distinct median lobe (e.g. Figs 342, 385). *Anthidium andinum* can be easily separated from the South American species by the larger body size ( $\geq 11$  mm in body length), tegula and legs dark brown to black, and shape of female T6 (Fig. 129) and male T7 (Fig. 208).

**Description: Female.** Body length 11.5–13.8 mm; forewing length 9.5–9.8 mm. **Structure.** Clypeus flat, distal margin sinuous with distinct, obtuse sublateral projections (Fig. 49); mandible elongated, with six or seven teeth; labrum with low basal protuberances, separated by about three times width of protuberance, preapical projections large, distinctly curved upwards; F1 2.4× longer than broad, slender, about as long as combined lengths of F2 and F3. Tibial carina present. T6 straight in profile, preapical carina



minutely serrate, with small submedian spine, depressed apical rim projecting on median one-quarter of distal margin (Fig. 129). *Coloration*. Black, except brownish on distitarsi; yellow maculations as follows: rounded to oval spot laterally on vertex, small spot laterally on T1 (sometimes absent), T2–T6 with medially interrupted bands, closer, wider on apical segments, laterally weakly notched on posterior margin. Wings brown with weak greenish and coppery reflections distally; veins and stigma dark brown. *Pubescence*. Whitish, except: brownish hairs on clypeus, supraclypeal area, frons, vertex, discs of scutum and scutellum, inner surfaces of tarsi, outer surface of middle basitarsus, depressed marginal zones of T2–T4, and T5 and T6 entirely; sternal scopa whitish to yellowish. Clypeus, supraclypeal area, and frons covered with simple, stiff, apically curly or hooked hairs, denser on clypeus. Outer surfaces of fore and mid basitarsi densely covered by tomentum, denser on fore basitarsus (integument not visible among hairs). Fore basitarsus with fringe of long hairs ( $2\times$  basitarsal width) along posterior margin. *Sculpturing*. Clypeus, supraclypeal area, and frons dull between coarse, sparse ( $1\text{--}2\times$  PW) punctures, integument finely imbricate, shinier on clypeus. Propodeal triangle dull, finely lineolate. T1–T5 with weakly elevated discal areas, shiny, weakly lineolate or imbricate between coarse, sparse punctures ( $2\text{--}3\times$  PW); depressed marginal zones more densely punctate than on discs ( $\leq 1\times$  PW); distal margins smooth, about one-quarter width of depressed marginal zone.

*Male*. Body length 15 mm; forewing length 11 mm. *Structure*. Mandible with four teeth, third tooth obliquely truncate, sometimes reduced, thus appearing as three-toothed mandible with long upper interspace; labrum with reduced basal protuberances, nearly absent; F1 twice as long as broad, shorter ( $0.7\times$ ) than combined lengths of F2 and F3. Lateral spine of T6 curved, much shorter than median spine of T7; lateral lobe of T7 spiniform, about as wide as and slightly shorter than median spine (Fig. 208); S4 with distal margin straight, without apical brush of hairs, only barely indicated by darker and denser hairs medially; S6, in ventral view, with basal margin gently convex, laterally with small, acute spine, distal margin convex, medially emarginate, semicircular emargination more than twice as broad as long (Fig. 333); S7 hemisternite somewhat apically truncate (Fig. 410); S8 (Fig. 46) with long, narrow apical process, apex broad, obliquely truncate, gently curved in profile. Genitalia: gonostylus robust,  $2.3\times$  longer than broad; volsella small, less than one-third of gonostylar length, obliquely truncate, appearing triangular in ventral view; penis valve about as long as gonostylus in ventral view, apex long, curved,

dorsoapical patch of hairs absent, medial projection large, distinct. *Coloration*. As in female except: yellow on outer surface of mandible (sometimes reduced), apicolateral areas of clypeus (sometimes connected by premarginal band), and T7 (sometimes with diffuse spots). *Pubescence*. Tarsi with whitish hairs on outer surface. *Sculpturing*. Face and terga slightly shinier than in female; clypeus with finer, closer punctures on distal half.

*Distribution*: ARGENTINA: Mendoza, Salta; BOLIVIA: Cochabamba (1900–4400 m a.s.l.). Recorded from the Central Andean puna, High Monte, Southern Andean Yungas, and Bolivian montane dry forest ecoregions.

*Phenology*: January–April, July, October.

*Comments*: The fringe of long hairs along the fore basitarsus of the female resembles that of *A. palliventre* from North America. Such a fringe is presumably used to excavate nests in sand dunes. The type of *A. andinum* could not be examined.

#### *ANTHIDIUM ANUROSPILUM* MOURE, 1957

FEMALE, FIGS 50, 130; MALE, FIGS 209, 283, 334, 411, 487

*Anthidium anurospilum* Moure, 1957: 216 (holotype: DZUP; ♀, Antofagasta, Toconao, Chile).

*Diagnosis*: The female of this species can be recognized by the following combination of characters: clypeus weakly convex with distal margin thick, straight or slightly concave medially (Fig. 50); basitarsi with outer surfaces not covered by tomentum (integument visible among hairs); hind tibia and basitarsus with outer surfaces sparsely covered with distinctly shorter and thicker hairs than those on anterior margin; hind tibia without carina; sternal scopa black; and T6 with small but distinct lateral angle and depressed apical rim translucent, projecting across nearly median half ( $\sim 0.4\times$ ) of distal margin (Fig. 130). The male can be easily recognized by the following combination of characters: T7 with narrow, apically divergent lateral lobes (Fig. 209); S4 with apical brush of dense, short hairs on median two-fifths of distal margin (Fig. 283); and S6 with lateral lobe acute and median lobe with anteriorly curved apex (Fig. 334).

*Description: Female*. Body length 10.8 mm; forewing length 8.2 mm. *Structure*. Clypeus weakly convex, projected about  $0.4\times$  width of compound eye in profile, distal margin thick, straight or medially concave, not strongly projected sublaterally (Fig. 50); mandible with six teeth; labrum without basal protuberances,

preapical projections barely indicated by elevated border on lateral margin of furrow; F1 twice as long as broad, about as long as combined lengths of F2 and F3. Tibial carina absent. T6 straight in profile, with small but distinct lateral angle or spine, preapical carina minutely crenulate, depressed apical rim translucent, projecting on nearly median half ( $\sim 0.4\times$ ) of distal margin (Fig. 130). *Coloration*. Black, except ferruginous on outer surface of mandible (usually), antenna (except F5–F10 dark brown), pronotal lobe (usually), tegula, apices of femora, and remaining segments of legs; cream or yellow maculations as follows: rounded to oval spot laterally on vertex (sometimes complete broad band) and T1–T5 with medially interrupted bands, closer on apical terga, laterally weakly notched on posterior margin (bands sometimes reduced to lateral spots on basal terga). Wings light orange basally, brownish distally, with weak greenish and coppery reflections; veins ferruginous basally (including stigma and prestigma), dark brown distally. *Pubescence*. Black, except whitish to grey hairs usually on inferior paraocular area, vertex, dorsum, sides of mesosoma, and sides of T1–T3; ferruginous hairs on scape and ferruginous areas of legs. Outer surfaces of hind tibia and basitarsus sparsely covered with distinctly shorter, thicker hairs than those on anterior margin. *Sculpturing*. Propodeal triangle weakly shiny, lineolate to imbricate. T1–T5 with weakly elevated discal areas, glossy, sparsely punctate ( $\geq 3\times$  PW); depressed marginal zones more densely punctate than on discs ( $1\text{--}2\times$  PW); distal margins smooth, shiny, about one-third of depressed marginal zone.

*Male*. Body length 11.2–12.3 mm; forewing length 9.0–9.2 mm. *Structure*. F1  $1.7\times$  longer than broad, shorter ( $0.7\times$ ) than combined lengths of F2 and F3; lateral spine of T6 gently curved, about as long as median spine of T7; lateral lobe of T7 elongate, about as wide as distance between inner margin and median spine, outer margin straight, inner margin oblique, distinctly diverging apically (Fig. 209); S4 with apical brush of dense, short hairs on median two-fifths of straight distal margin (Fig. 283); S6, in ventral view, with basal margin medially projected, lateral lobe long, pointed, laterally directed, median lobe triangular, with anteriorly curved apex (Fig. 334); S7 hemisternite as in Figure 411; S8 with short, basally broad apical process, gently curved in profile (Fig. 487). Genitalia: gonostylus robust,  $2.7\times$  longer than broad; volsella small, about one-third of gonostylar length, apically truncate, ventrally pointed; penis valve about two-thirds of gonostylar length, blade-like, apically curved, dorsoapical patch of hairs reduced or absent, medial projection large, distinct. *Coloration*. As in female except: antenna with F4–F11 dark brown; yellow or cream macula-

tions on outer surface of mandible, clypeus, and inferior paraocular area. *Pubescence*. Face, antennal scape, and foreleg with whitish hairs.

*Distribution*. ARGENTINA: Jujuy, Tucumán; CHILE: Antofagasta (3800–4400 m a.s.l.). Recorded from Central Andean dry puna, Central Andean puna, and Southern Andean Yungas ecoregions.

*Phenology*: February–June, November.

*Comments*: Unlike specimens from Chile, the clypeal margin is straight in the females examined from Argentina. They also have cream or yellow markings more developed on the vertex and terga than the holotype; however, other specimens from Chile also have well-developed markings on these areas of the body, suggesting a similar variation in colour to that found in *A. decaspilum* (see species account).

#### **ANTHIDIUM ATACAMENSE SP. NOV.**

FEMALE, FIGS 51, 131; MALE, FIGS 210, 335, 412, 488, 564

*Diagnosis*: This species is most similar to *A. espinosai* and *A. nigerrimum*. It shares with those species the following combination of characters: female clypeus prominently convex (Fig. 51); female T6 with median spine on distal margin (Fig. 131); and male T7 apically narrowed, with lateral lobes close together beneath the median spine (Fig. 210). The female of *A. atacamense* sp. nov. can be separated from these related species by T6, which is sparsely striate-punctate, with the distal margin not strongly projected laterally, and usually also bearing a submedian spine. The male can be separated from those species by S4, which lacks an apical brush, and by S6, which has the distal margin reflexed and thin along the entire border (Fig. 335).

*Description (paratypes in parentheses): Female*. Body length 10.0 mm (10.0–10.3 mm); forewing length 7.4 mm (7.4–7.7 mm). *Structure*. Clypeus prominently convex, projected about  $0.6\times$  width of compound eye in profile, distal margin thin, gently tuberculate (Fig. 51); mandible with six teeth; labrum without basal protuberances, preapical projections barely indicated by elevated border on lateral margin of furrow; F1 twice as long as broad, slightly longer than combined lengths of F2 and F3. Tibial carina absent. T6 convex in profile, with small but distinct lateral angle, distal margin broadly rounded with distinct median spine (also with shorter submedian spine in some paratypes), depressed apical rim absent (Fig. 131). *Coloration*. Black, except ferruginous on outer surface of mandible basally (darkened in some

paratypes), antenna (except superior margin of F5–F10 and apex of F10 dark brown), tegula and legs, except for coxae, trochanters, and bases of femora; cream maculations as follows: four short, thin ( $\leq$  OD) bands on vertex (complete in one paratype), and T1–T5 with medially interrupted bands, closest on T5. Wings light orange basally, brownish distally, with weak greenish and coppery reflections; veins ferruginous basally (including stigma and prestigma), dark brown distally. *Pubescence*. Head and mesosoma mostly with whitish hairs, except ferruginous hairs on scape, dorsum of mesosoma, and ferruginous areas of legs; intermingled darker hairs on face, vertex, pronotal lobe, scutellum, upper portion of mesepisternum and metepisternum, sides of propodeum, coxae, trochanters, and bases of femora; metasoma with dark brown to black hairs, except sides of T1–T3 with whitish hairs. Outer surface of fore basitarsus densely covered with tomentum (integument not visible among hairs). Outer surfaces of hind tibia and basitarsus sparsely covered with distinctly shorter, thicker hairs than those on anterior margin. *Sculpturing*. Supraclypeal area elevated and impunctate along midline. Propodeal triangle weakly shiny, lineolate to imbricate. T1–T5 with weakly elevated discal areas, glossy, sparsely punctate ( $\geq 3 \times$  PW); depressed marginal zones more densely punctate than on discs ( $1\text{--}2 \times$  PW); distal margins about one-sixth to one-third of depressed marginal zone.

*Male*. Body length 10.8–11.5 mm; forewing length 8.5–8.9 mm. *Structure*. F1  $1.8 \times$  longer than broad, shorter ( $0.8 \times$ ) than combined lengths of F2 and F3. Labrum without preapical projections. Lateral spine of T6 strongly curved, distinctly longer and stouter than lateral lobe and median spine of T7; T7 narrowed apically, lateral lobe spiniform, close, ventral to median spine (Fig. 210); S4 without apical brush, distal margin gently concave; S6, in ventral view, with basal margin strongly convex, distal margin somewhat truncated, with thin, reflexed distal edge on entire margin (Fig. 335); S7 hemisternite distally pointed (Fig. 412); S8 with medially projected distal margin, not forming distinct apical process (Fig. 488). Genitalia: gonostylus robust,  $3.0 \times$  longer than broad, distinctly narrowed basally; volsella small, about one-third of gonostylar length, obliquely truncate in profile, dorsally projecting into lobe; penis valve about as long as gonostylus, apex digitiform, dorsoapical patch of hairs absent, medial projection large, distinct (Fig. 564). *Coloration*. As in female, except: dark brown on posterior surface of F4–F11; yellow or cream maculations on outer surface of mandible, clypeus, and inferior paraocular area; T1–T4 with lateral bands slightly more separated than in female. *Pubescence*. Face, scape and posterior surface of fore femur with whitish hairs. *Sculpturing*. Terga with impunc-

tate distal margins broader than in female, about half width of depressed marginal zone.

*Holotype*: ♀, CHILE: region II, Atacama Province (Antofagasta, El Loa), 35 km E San Pedro de Atacama,  $22^{\circ}55.61'S$ ,  $67^{\circ}51.52'W$ , 4218 m a.s.l., 19–28.X.2003; pan trap, FD Parker, M Irwin, FDP#5192 (MEUC).

*Paratypes*: 7 females, 4 males. CHILE: Antofagasta, Antofagasta Prov., 1♂, 1♀, Quillagua, 28 Sep 1970, C. Pizarro; El Loa Prov., 3♂, 6♀, same data as holotype except for specimen numbers (BBSL, FSAC, MEUC).

*Additional material*: ARGENTINA: Jujuy, 1♀, Mina Aguilar, 6–8 Nov 1968, C.C. Porter; 2♀, Paso de Jama, 2 km E, 4233 m a.s.l.,  $W67^{\circ}03.28'$ ,  $S23^{\circ}13.44'$ , 14 Nov–21 Dec 2003, Parker F.D., Irwin M.E. BOLIVIA: Potosí, 1♀, Laguna Hedionda, SW of Calcha, 4500 m a.s.l. Dec. 17, 1975, L.E. Peña (AMNH, BBSL, FSAC).

*Distribution*: Northern CHILE: Antofagasta; ARGENTINA: Jujuy; BOLIVIA: Potosí (3500–4500 m a.s.l.). Recorded from the Central Andean dry puna and Central Andean puna ecoregions.

*Phenology*: May, October, December.

*Etymology*: The name of this species refers to the type locality in xeric northern Chile.

*Comments*: A few specimens from Argentina and Bolivia may well belong to this species (see additional material). They differ slightly from the Chilean specimens, and therefore were not included in the type series. In the Bolivian specimen, the terga are shinier and T6 is more angled laterally. The Argentinean specimens are slightly larger, with T6 not distinctly angled laterally, more coarsely and densely striate-punctate, and with punctures nearly contiguous (T6 is sparsely striate-punctate, with distinct large glossy areas in *A. atacamense* sp. nov.); the clypeal margin is also thicker in one of them. These differences might represent geographical variation; more material is needed to determine if this is the case.

#### *ANTHIDIUM ATRIFRONS* CRESSON, 1868 STAT. NOV.

FEMALE, FIGS 52, 132; MALE, FIGS 211, 284, 336, 413, 489; MAP, FIG. 576

*Anthidium atrifrons* Cresson, 1868: 387 (lectotype: ANSP 2726; ♀, New Mexico, USA); Cresson, 1916: 112 (type designation); Michener, 1951: 1140 (synonymy with *emarginatum*).



*Anthidium atriventre* Cresson, 1878: 111 (lectotype: ANSP 2392; ♀, California, USA); Cresson, 1916: 112 (type designation); Grigarick & Stange, 1968: 21 (synonymy with *emarginatum*).

*Anthidium saxorum* Cockerell, 1904b: 57 (holotype: AMNH; ♂, Rock Creek, California, USA); Grigarick & Stange, 1968: 21 (synonymy with *emarginatum*).

*Anthidium collectum* var. *ultrapictum* Cockerell, 1904c: 73 (holotype: AMNH; ♂, Tehachapi, California, USA); Grigarick & Stange, 1968: 21 (synonymy with *emarginatum*).

*Anthidium titusi* Cockerell, 1904b: 58 (holotype: AMNH; ♂, Fort Collins, Colorado, USA); Grigarick & Stange, 1968: 21 (synonymy with *emarginatum*).

*Anthidium bernardinum* var. *aridum* Cockerell, 1904b: 58 (holotype: AMNH; ♂, Rock Creek, California, USA); Grigarick & Stange, 1968: 21 (synonymy with *emarginatum*).

*Anthidium fresnoense* Cockerell, 1925a: 347 (holotype: CAS 1729; ♀, Huntington Lake, Fresno Co., California, USA); Timberlake in Michener, 1951: 1139 (synonymy with *atriventre titusi*); Grigarick & Stange, 1968: 21 (synonymy with *emarginatum*).

*Anthidium angulatum* Cockerell, 1925a: 357 (holotype: CAS 1737; ♂, Huntington Lake, Fresno Co., California, USA); Grigarick & Stange, 1968: 21 (synonymy with *emarginatum*).

*Anthidium hamatum* Cockerell, 1925a: 358 (holotype: CAS 1739; ♂, Mt. Timpanogos, Utah, USA); Timberlake in Michener, 1951: 1139 (synonymy with *atriventre atriventre*); Grigarick & Stange, 1968: 21 (synonymy with *emarginatum*).

*Anthidium spinosum* Cockerell, 1925a: 359 (holotype: CAS 1740; ♂, Fallen Leaf Lake, California, USA); Timberlake in Michener, 1951: 1139 (synonymy with *atriventre atriventre*); Grigarick & Stange, 1968: 21 (synonymy with *emarginatum*).

*Anthidium lucidum* Cockerell, 1925a: 361 (holotype: CAS 1743; ♂, Huntington Lake, Fresno Co., California, USA); Timberlake in Michener, 1951: 1139 (synonymy with *atriventre titusi*); Grigarick & Stange, 1968: 21 (synonymy with *emarginatum*).

*Anthidium sculleni* Schwarz, 1930: 10 (holotype: CAS 12030; ♂, Wallowa Lake, Oregon, USA); Grigarick & Stange, 1968: 21 (synonymy with *emarginatum*).

**Diagnosis:** This species is highly variable in the colour of the pubescence and integument (see description and comments below). Because of this variation, dark-haired, ivory maculated females can be easily confused with *A. emarginatum*, whereas pale-haired, heavily yellow maculated specimens can be confused with *A. tenuiflorae* or *A. collectum*. *Anthidium atrifrons* can be separated from the former species, in addition to the apparent altitudinal allopatry (*A. atri-*

*frons* primarily occurs in montane habitats, whereas *A. emarginatum* occupies lowland environments), by the denser tomentum on the outer surface of the fore basitarsus and the depressed apical rim of T6 progressively disappearing about halfway between the median emargination and lateral angle (Fig. 132). The depressed apical rim of T6 also clearly distinguishes *A. atrifrons* from the other two species. In *A. tenuiflorae*, the apical rim extends across almost the entire distal margin, with a weak to nearly absent median emargination (Fig. 202); also, the clypeus is weakly convex to nearly flat in profile, whereas it is prominently convex in *A. atrifrons* (compare Figs 52 and 125). In *A. collectum*, the disc of T6 is not as swollen as in *A. atrifrons*, and the apical rim is more projected (compare Figs 132 and 144); also, the terga are duller and more coarsely punctate, especially on the depressed marginal zones. The male resembles that of *A. dammersi* in the broad, not semicircular, submedian emargination of T7, but it can be separated by the shape of the lateral lobe of T7 (Fig. 211) and S6 (Fig. 336), and the more densely punctate depressed marginal areas of T1–T5; the integument of the terga is also usually shinier than in *A. dammersi*.

**Description:** *Female.* Body length 7.5–10 mm; forewing length 6.3–6.8 mm. **Structure.** Clypeus prominently convex, projected about 0.4× width of compound eye in profile, distal margin thin, wavy, sometimes gently tuberculate, two lateralmost tubercles usually more distinctly produced (Fig. 52); mandible with five teeth; labrum without basal protuberances, preapical projections large, distinctly curved basally; F1 about twice as long as broad, slightly shorter (~0.9×) than combined lengths of F2 and F3. Tibial carina absent. T6 with disc gently swollen preapically, without distinct lateral angle, preapical carina absent, depressed apical rim narrow, progressively disappearing to about halfway between median emargination and lateral angle (Fig. 132). **Coloration.** Dark brown to black, except ivory or yellow maculations as follows: outer surface of mandible, clypeus, inferior paraocular area (usually absent), rounded to oval spot laterally on vertex, pronotal lobe, tegula except on disc, anterolateral and lateral margins of scutum (usually reduced or absent), axilla (usually reduced), distal margin of scutellum except medially, outer surfaces of tibiae basally (sometimes entire surface), outer surfaces of basitarsi (usually absent), terga with bands usually narrowed medially (sometimes weakly interrupted, especially on T1 and T6), laterally weakly notched on anterior margin. Wings hyaline, slightly brownish; veins and stigma dark brown. **Pubescence.** Highly variable in colour, entirely pale, yellowish, dark

brown or black, including sternal scopa. Fore and mid basitarsi with outer surfaces densely covered by whitish or brown tomentum (integument not visible among hairs), thus segment appearing robust, with short, semierect, unbranched hairs. *Sculpturing*. Propodeal triangle finely lineolate, weakly shiny. T1–T5 with weakly elevated discal areas, usually finely imbricate to lineolate, weakly shiny; depressed marginal zones with smaller, coarser, denser ( $\leq 1 \times$  PW) punctures than on discs; distal margins with distinct, narrow ( $1\text{--}3 \times$  PW), smooth, shiny border.

*Male*. Body length 11.5–13.1 mm; forewing length 7.7–8.9 mm. *Structure*. F1  $1.4 \times$  longer than broad, shorter ( $0.6 \times$ ) than combined lengths of F2 and F3; preapical labral projections longer than in female. Lateral spine of T6 straight or nearly straight, about as long as median spine of T7; lateral lobe of T7 narrowed apically, basally about as wide or slightly wider ( $1.2 \times$ ) than distance between inner margin and median spine, inner margin distally parallel with median spine, outer margin gently curving medially (Fig. 211); S4 with broad (about one-third sternal width), dense, black hair brush of short hairs on nearly straight distal margin (Fig. 284); S6, in ventral view, with gently convex basal margin, lateral lobe acute, median lobe narrow, nearly parallel-sided, apically truncate (Fig. 336); S7 hemisternite somewhat distally truncate (Fig. 413); S8 with broad apical process, about one-third of distal margin basally, deeply bifid apically, with pointed lobes ventrally bent ( $\sim 100^\circ$ ) in profile view (Fig. 489). Genitalia: gonostylus robust,  $3.8 \times$  longer than broad, apically truncate in profile view, nearly straight, with somewhat pointed apex in ventral view; volsella small, about one-third of gonostylar length, obliquely truncate, appearing triangular in ventral view; penis valve about half of gonostylar length, dorsoapical patch of hairs present, medial projection reduced or absent. *Coloration*. As in female, except ivory or yellow maculations as follows: outer surface of mandible, clypeus, except sometimes distal margin, inferior paraocular area, axilla (usually reduced or absent), distal third of scutellum, except medially (usually reduced or absent), and outer surfaces of basitarsi; bands of T1–T6 laterally often more deeply notched than in female; T7 usually black, sometimes with two large spots. *Pubescence*. Predominantly whitish, light brown to yellowish on inner surfaces of legs and sometimes on sterna.

*Distribution*. USA: Pacific Coast states to Wyoming, Colorado, and Arizona in diverse ecoregions (100–3300 m a.s.l., mostly 1000–3000 m a.s.l.). Partially sympatric with *A. emarginatum*, but typically occurs at higher elevations (Fig. 576).

*Phenology*: April–early October; most records (90%) from June through first half of August.

*Floral records*: Majority of visits to *Phacelia* (64%). APIACEAE: *Heracleum lanatum*. ASTERACEAE: *Chaenactis* sp.; *Senecio* sp. BORAGINACEAE: *Cryptantha* sp.; *Nama rothrockii*; *Phacelia adenophora*, *Phacelia alba*, *Phacelia frigida*, *Phacelia hastata*, *Phacelia heterophylla*, *Phacelia leucophylla*, *Phacelia linearis*, *Phacelia ramosissima*. BRASSICACEAE: *Sisymbrium altissimum*. CAPRIFOLIACEAE: *Symphoricarpos* sp. CARYOPHYLLACEAE: *Arenaria* sp. CRASSULACEAE: *Sedum lanceolatum*. FABACEAE: *Amorpha fruticosa*; *Astragalus drummondii*; *Lotus* sp.; *Lupinus caudatus*, *Melilotus* sp.; *Trifolium hybridum*. LAMIACEAE: *Marubium vulgare*. ONAGRACEAE: *Clarkia pulchella*, *Epilobium angustifolium*. PLANTAGINACEAE: *Besseya plantaginea*, *Penstemon cyaneus*. POLEMONIACEAE: *Gilia capitata*. POLYGONACEAE: *Eriogonum heracleoides*, *Eriogonum ovalifolium*, *Eriogonum umbellatum*. ROSACEAE: *Horkelia* sp., *Ivesia rhypara*, *Rubus* sp.

*Comments*: This species is resurrected from synonymy under *A. emarginatum* (Grigarick & Stange, 1968); both species are quite distinct and easy to recognize, as indicated in the key to species. The female of *A. atrifrons* appears twice in the key because of the colour variation in the pubescence and integument. The hairs on the legs and sternal scopa range from entirely white to dark brown or black, sometimes with a mixture of both; the integument of the face, scutum, and legs ranges from entirely black, without any maculations, to entirely bright yellow on clypeus, lower paraocular area, mandible, margins of scutum, femora, and hind basitarsus. Although colour variants sometimes occur even within the same locality (Grigarick & Stange, 1968, as *A. emarginatum*), both sexes from central and southern California (e.g. Yosemite National Park, San Bernardino) tend to have more extensive bright-yellow markings than specimens from other localities; the depressed marginal zones of the terga are also more coarsely punctate in the specimens from California. Despite the geographic pattern in markings, we did not find consistent corresponding differences in the shape of T6 of the female, nor in T7, S6–S8, and genitalia of the male, that would reliably separate these colour forms.

Because of the considerable variation in colour, numerous names have been proposed for colour variants, as indicated in the long list of synonymies. Misidentifications based on colour were also common; for instance, among the paratypes of *A. astragali* (= *A. emarginatum*) deposited at the UNSM we found a female of *A. atrifrons* from Ute Creek, Colorado. We also examined two specimens of *A. atrifrons*, one of

each sex, deposited at the ANSP and identified by Cresson (1864) as *A. emarginatum*; the female is missing the head. Both specimens were presumably collected in Kansas, as indicated by a small label that reads 'Ks'; however, this record seems to be an error because *A. atrifrons* is not known to occur there.

*ANTHIDIUM ATRIPES* CRESSON, 1879

FEMALE, FIGS 53, 133; MALE, FIGS 212, 285, 337, 414, 490; MAP, FIG. 576

*Anthidium emarginatum* var. *atripes* Cresson, 1879: 205 (holotype: ANSP 2654; ♀, Nevada, USA); Cresson, 1916: 112 (unnecessary lectotype designation); *Anthidium atripes*; Schwarz, 1928: 388 (change of status).

*Anthidium polingae* Schwarz, 1931: 315 (holotype: OSAC 63650; ♂, Jeff Davis Co., Texas, USA); Grigarick & Stange, 1968: 13 (synonymy with *atripes*).

**Diagnosis:** Both sexes of this species are similar to *A. atripoides* sp. nov. in the following combination of characters: female usually large and robust (~8–11 mm); T3–T5 with depressed marginal zones weakly and sparsely punctate, without distinctive smooth and shiny distal margins; male S4 with broad black brush; S6 with lateral lobe low or absent; and S8 bifid apically. Females of *A. atripes* can be distinguished from all other Nearctic *Anthidium*, except *A. atripoides* sp. nov. and some *A. atrifrons*, by the legs with black pubescence. From dark-haired *A. atrifrons* it can be separated by the marginal areas of the terga with sparse punctation, T5 and T6 without maculations, and mandible with six teeth. From *A. atripoides* sp. nov., it can be separated by the clypeus with thinner apical margin (compare Figs 53 and 54), and the fore and mid basitarsi with outer surfaces more densely covered with tomentum; the pronotal lobe is also usually yellow. Smaller females of *A. atripes* can be confused with *A. emarginatum*, but in the latter species the fore and mid basitarsi are sparsely covered by tomentum on the outer surfaces (integument largely visible among hairs) and the T1–T5 are shinier, with the depressed marginal zones more coarsely and densely punctate ( $\leq 1$  PW) medially (Fig. 27). The male differs from that of *A. atripoides* sp. nov. in the broad lateral lobe of T7 (compare Figs 212 and 213), S4 with distal margin of brush broadly concave (Fig. 285 versus Fig. 41), and S6 with apex of median lobe incised (Fig. 337 versus Fig. 338).

**Description: Female.** Body length 7.7–11.5 mm; forewing length 6.9–8.5 mm. **Structure.** Clypeus prominently convex, projecting about 0.4× width of compound eye in profile, distal margin thin, wavy,

sometimes gently tuberculate, two lateralmost tubercles usually more distinctly projected (Fig. 53); mandible with six teeth; labrum without basal protuberances, preapical projections large, distinctly curved upwards; F1 1.7× longer than broad, shorter (~0.8×) than combined lengths of F2 and F3. Tibial carina absent. T6 with nearly truncate distal margin, depressed apical rim narrow, visible across entire distal margin (Fig. 133). **Coloration.** Black, except dark brown on antennal flagellum and distitarsi; cream or yellow maculations as follows: rounded to oval spot laterally on vertex, pronotal lobe (sometimes entirely black), tegula except on disc, anterolateral and lateral margins of scutum (usually reduced or absent), axilla (usually reduced or absent), distal third of scutellum except medially (sometimes reduced), outer surfaces of tibiae basally (usually absent, rarely extending on entire tibial surface), T1–T3 with medially interrupted bands, each lateral band distinctly notched anteriorly (rarely broken), T4 with two submedian bands (usually reduced or absent), and T5 and T6 sometimes with diffuse spot. **Pubescence.** Usually dark brown to black, including scopa, except whitish hairs on frons, vertex, pronotal lobe, scutum, scutellum, axilla, and sides of T1 and T2 (sometimes on mesepisternum, legs, and terga). Outer surfaces of basitarsi densely covered by tomentum (integument not visible among hairs). **Sculpturing.** Propodeal triangle finely lineolate, weakly shiny. T1–T5 with weakly elevated discal areas, finely imbricate–lineolate, weakly shiny, with some punctures continuing into weak grooves distally; depressed marginal zones, particularly on T3–T5, finely, weakly punctate medially (1–3× PW); distal margins dull, little or not differentiated from rest of depressed marginal zone, about one-quarter width of punctate depressed marginal zone.

**Male.** Body length 10.8–14.5 mm; forewing length 8.5–9.7 mm. **Structure.** F1 1.4× longer than broad, shorter (0.6×) than combined lengths of F2 and F3; preapical labral projections longer than in female. Lateral spine of T6 straight or nearly straight, about as long as median spine of T7; lateral lobe of T7 about as wide as distance between inner margin and median spine, outer margin straight or nearly straight, inner margin gently curving towards submedian emargination (Fig. 212); S4 with broad (0.4× sternal width), dense, black hair brush on medially concave distal margin (Fig. 285); S6, in ventral view, narrowly obliquely truncate laterally, without acute lateral lobe, median lobe short, broad, weakly notched apically (Fig. 337); S7 hemisternite as in Figure 414; S8 with narrow apical process, about one-quarter width of distal margin basally, deeply bifid apically, with pointed lobes ventrally bent in nearly right angle (Fig. 490). Genitalia: gonostylus 3.0× longer



than broad; volsella small, about one-third of gonostylar length, obliquely truncate, appearing triangular in ventral view, preapically emarginate on posterior margin; penis valve about half of gonostylar length, dorsoapical patch of hairs present, medial projection reduced or absent. *Coloration*. As in female, except cream or yellow maculations as follows: outer surface of mandible, clypeus except apical margin, inferior paraocular area, pronotal lobe (sometimes reduced), axilla (usually reduced or absent), distal third of scutellum except medially (usually reduced or absent), outer surfaces of basitarsi (usually absent), and lateral bands on T1–T4 deeply notched (usually broken); T5 and T6 usually with two submedian spots. *Pubescence*. Whitish hairs on head and mesosoma; dark brown to black hairs on gena and legs. *Sculpturing*. Propodeum mostly smooth, shiny between punctures.

*Distribution*. USA: Southern California, north along the east side of the Sierra Nevada, to eastern Oregon, southern Idaho, western Colorado; west Texas. MEXICO: Baja California. Apparently absent from Arizona and New Mexico. Intermediate elevations (1100–3200 m a.s.l.) in the mountains west of the Rocky Mountains, but absent from desert and forest ecoregions. An azonal record, a single male from Antioch, California, is anomalous. Given the absence of additional records in the extensively collected region west of the Sierra Nevada crest, this record is viewed as a likely labelling error, and is not mapped. A disjunct population apparently exists in the Davis Mountains of western Texas (Fig. 576).

*Phenology*. May–July, single record each in late August, mid September, and early November; most records (93%) from last half of May through first half of July.

*Floral records*. ASTERACEAE: *Agoseris glauca*; *Chaenactis* sp.; *Chrysothamnus* sp.; *Cirsium* sp.; *Townsendia incana*. BORAGINACEAE: *Cryptantha micrantha*; *Phacelia crenulata*. BRASSICACEAE: *Stanleya pinnata*. FABACEAE: *Astragalus aequalis*, *Astragalus beckwithii*, *Astragalus confertifloris*, *Astragalus douglasi* var. *parishii*, *Astragalus filipes*; *Dalea searlsiae*; *Hedysarum boreale*; *Lathyrus brachycalyx* ssp. *zionis*; *Lotus argyraeus*, *Lotus davidsonii*, *Lotus grandiflorus*, *Lotus nevadensis*, *Lotus nevadensis* var. *davidsonii*, *Lotus oblongifolius*; *Lupinus* sp.; *Melilotus officinalis*. MALVACEAE: *Sphaeralcea grossulariifolia*. PLANTAGINACEAE: *Penstemon comarrhenus*, *Penstemon leiophyllus*, *Penstemon thompsoniae* ssp. *jaegeri*. POLEMONIACEAE: *Gilia inconspicua*.

*Comments*. Schwarz (1931) described *A. polingae* from 11 females and three males from the same locality. Seven females and two males are deposited at OSAC, whereas the remaining specimens are at the AMNH. Although Schwarz did not explicitly mention the sex of the holotype in the original description, he indicated that one of the figures showing the T7 of the male (Schwarz, 1931: 317, 321, fig. 1) corresponded to the type (= holotype), whereas the other corresponded to a paratype. However, one of the seven females, OSAC 63654, has a holotype label, whereas all others, including one of the two males with extracted genitalia (metasoma also missing), have paratype labels. The remaining male (OSAC 63650) has an allotype label and, judging by the resemblance with Schwarz's figure 1, there is no doubt it is the type specimen. Grigarick & Stange (1968) listed the holotype as a female, but did not comment on the discrepancy with Schwarz's publication. To avoid further confusion, we added a red label for the male mistakenly labelled 'allotype' with the following note: 'This is the true type, as indicated in Figure 1 of Schwarz's (1931) publication. V.H. Gonzalez & T. Griswold 2010'.

Specimens from southern California and Baja California tend to be more heavily maculated than specimens from other localities.

#### *ANTHIDIUM ATRIPOIDES* SP. NOV.

FEMALE, FIGS 54, 134; MALE, FIGS 41, 47, 213, 338, 415, 491; MAP, 576

*Diagnosis*. Both sexes of this species are similar to those of *A. atripes* (see above). In addition to the characters indicated in the diagnosis of *A. atripes*, they can be distinguished by the metasoma with shinier integument and the male S8 with apex shallowly bifid (Fig. 415).

*Description (paratypes in parentheses): Female*. Body length 10 mm (8.5–11.5); forewing length 7.8 mm (6.9–8.0). *Structure*. Clypeus prominently convex, projected about 0.5× width of compound eye in profile, distal margin distinctly thickened (Fig. 54), not wavy or tuberculate as in *A. atripes*; mandible with five teeth; labrum without basal protuberances, preapical projections large, distinctly curved upwards; F1 1.5× longer than broad, shorter (~0.7×) than combined lengths of F2 and F3. Tibial carina absent. T6 with disc gently swollen preapically, without distinct lateral angle, distal margin truncate, depressed apical rim visible across entire distal margin (Fig. 134), not as projected as in *A. atripes*. *Coloration*. Black, except dark brown on antennal flagellum, mandible, and distitarsi; cream maculations as follows: rounded to oval spot laterally on vertex, anterolateral margin of tegula, T1–T3 with four short

bands (sometimes with medially interrupted bands, deeply notched laterally on anterior margin), T4 with two submedian bands, and T5 with single, very small ( $< 1.0 \times OD$ ), rounded, submedian spot (often absent). Wings hyaline, slightly brownish; veins and stigma dark brown. *Pubescence*. Black, except whitish hairs on vertex, scutum, axilla, scutellum, and tegula (mesepisternum, metepisternum, and propodeum usually with whitish hairs). *Sculpturing*. Propodeal triangle finely lineolate, weakly shiny. T1–T5 with weakly elevated discal areas, finely imbricate–lineolate, slightly shinier than in *A. atripes*, with some punctures continuing into weak grooves distally; depressed marginal zones, particularly on T3–T5, finely and weakly punctate medially ( $1\text{--}3 \times PW$ ); distal margins dull, little or not differentiated from rest of depressed marginal zone, about half width of punctate depressed marginal zone.

*Male*. Body length 9.2–11.5 mm; forewing length 6.9–8.8 mm. *Structure*. F1  $1.4 \times$  longer than broad, shorter ( $0.6 \times$ ) than combined lengths of F2 and F3; preapical labral projections longer than in female. Lateral spine of T6 straight or nearly straight, shorter than median spine of T7; lateral lobe of T7 wider ( $\sim 1.5 \times$ ) than distance between inner margin and median spine, outer margin straight, inner margin angled (Fig. 213); S4 with dense, short, black hair brush, occupying a little less than median one-third of straight distal margin (Fig. 41); S6, in ventral view, narrowly obliquely truncate laterally, without acute lateral lobe, median lobe short, broad (Fig. 338); S7 hemisternite distally truncate (Fig. 415); S8 with narrow apical process, about one-quarter width of distal margin basally (Fig. 491), not as deeply bifid as in *A. atripes*, with pointed lobes ventrally bent in nearly right angle. Genitalia (Fig. 47): gonostylus  $3.0 \times$  longer than broad; volsella about half of gonostylar length, ventroapical margin slightly projected, not emarginate on posterior margin; penis valve short, about half of gonostylar length, dorsoapical patch of hairs present, medial projection reduced or absent. *Coloration*. As in female except yellow or ivory maculations as follows: outer surface of mandible, clypeus (except sometimes apical margin), inferior paraocular area, outer surfaces of tibiae (usually absent), and T5 submedially. *Pubescence*. Dark brown to black, except whitish hairs on head, mesosoma, including legs and terga.

*Holotype*: ♀, USA: Utah, Garfield Co., 1 mi W., Wagon Box Mesa, 12S E491471, N4185695 nr2A99 // 24 May 2001, L. Topham (BBSL).

*Paratypes*: 52 females, 72 males. USA: Nevada, Clark Co., 1♂, Indian Ridge, 2.9 mi SW, 23 May 2005, *Stanleya pinnata*, R. Andrus; 1♀, Indian Ridge,

2.9 mi SW, 23 May 2005, *Phacelia fremontii*, S.M. Higbee; Elko Co., 1♀, Wendover, 10 mi S, 19 May 1962, G.E. Bohart; Esmeralda Co., 1♂, Indian Creek, 20 Jun 1973, L.W. Barclay, R.C. Bechtel; Humboldt Co., 1♂, McDermitt, 4 mi N, 23 Jun 1960, W.E. Ferguson; Lander Co., 1♂, Cambell Creek Ranch, 24 Jun 1981, J.B. Knight; Nye Co., 1♂, Darrough Hot Springs, 3 Jul 1980, J.B. Knight; 1♂, Eden Creek, Kawich Range, 12 Jun 1983, *Eriogonum umbellatum*, R.C. Bechtel, J.B. Knight; 1♂, Moores Creek, 6 Jun 1979, R.W. Rust; 1♀, Moores Creek, 6 Jun 1979, *Chaenactis*, R.W. Rust; Utah, Emery Co., 2♂, Buckskin Spring, 2 air mi NNE, 2 Jun 1982, T.L. Griswold; 2♂, 1♀, Buckskin Spring, N Goblin Valley, 2 Jun 1982, D.R. Frohlich, D.F. Veirs; 2♀, Buckskin Spring, N Goblin Valley, 29 May 1981, F.D. Parker; 3♂, Buckskin Spring, N Goblin Valley, 3 Jun 1982, T.L. Griswold; 1♀, Castledale, 9 air mi E, 7 Jun 1982, R. & T. Griswold; 1♂, North Temple Wash, 14 Jun 1983, F.D. & J.H. Parker; 1♂, Paige Flat, San Rafael Swell, 17 Jun 1983, T.L. Griswold; 1♂, San Rafael Reef, E edge, 2.8 mi S I-70, 27 Apr 1992, T.L. Griswold; 2♂, 4♀, Wild Horse Creek, N Goblin Valley, 3 Jun 1982, F.D. Parker, T.L. Griswold; Garfield Co., 1♂, Bitumen Mesa, 2.0 mi ENE, 3 Jun 2003, *Phacelia*, H. Ikerd; 1♀, Burr Trail, 7.4 mi S jct E end Wolverine, 25 May 2000, C.M. Davidson; 2♂, Duffy Mesa, 1.8 mi NNW, 7 Jun 2001, *Stanleya pinnata*, O.J. Messinger; 1♂, Horse Pasture, 3.9 mi S, 8 May 2003, *Xylorhiza tortifolia*, C.M. Davidson; 1♂, Horse Pasture, 3.9 mi S, 24 May 2001, *Stanleya pinnata*, O.J. Messinger; 1♂, Hot Canyon, 0.8 mi ESE, 29 Jun 2003, *Poliomintha incana*, H. Ikerd; 1♂, Hot Canyon, 0.9 mi S, 7 Jun 2003, *Poliomintha incana*, H. Ikerd; 1♀, Hot Canyon, 1.1 mi E, 7 Jun 2003, *Poliomintha incana*, H. Ikerd; 1♀, Impossible Peak, 0.7 mi SE, 17 May 2003, H. Ikerd, O.J. Messinger, C.M. Davidson, B. Bradley; 1♀, Lampstand, 0.9 mi SE, 25 May 2000, J. Janjic; 1♀, Long Canyon, 18 Jun 2003, *Cleome lutea*, H. Ikerd; 1♂, Long Canyon, 11 May 2001, *Astragalus*, O.J. Messinger; 1♂, Long Cyn, 0.8 mi NNW mouth, 25 May 2001, *Cleome lutea*, R. Andrus; 2♂, McGath Point, SW, 3 Jun 2003, *Poliomintha incana*, J.S. Wilson; 1♂, Mount Hillers, E slope, 16 Jun 1983, T.L. Griswold; 1♂, Pioneer Mesa, 1.7 mi WSW, 7 Jun 2001, *Dalea searlsiae*, C.M. Davidson; 1♀, Pioneer Mesa, 1.7 mi WSW, 7 Jun 2001, *Opuntia polyacantha*, C.M. Davidson; 1♂, 1♀, Pioneer Mesa, 1.7 mi WSW, 24 May 2001, *Stanleya pinnata*, C.M. Davidson; 6♂, 2♀, Pioneer Mesa, 1.7 mi WSW, 7 Jun 2001, *Stanleya pinnata*, C.M. Davidson; 1♂, Pioneer Mesa, 1.7 mi WSW, 24 Jun 2001, O.J. Messinger; 1♂, Pioneer Mesa, 1.7 mi WSW, 7 Jun 2001, *Dalea searlsiae*, S. Messinger; 2♂, Pioneer Mesa, 1.7 mi WSW, 7 Jun 2001, *Stanleya pinnata*, S. Messinger; 1♀, Steep Creek, 0.5 mi E jct Long Canyon, 16 Jun 2003,

*Stephanomeria*, H. Ikerd; 1♀, The Gulch, 25 May 2001, *Cleome lutea*, C.M. Davidson; 1♂, 2♀, The Gulch, 25 May 2001, *Cleome lutea*, S. Messinger; 2♂, Wagon Box Mesa, 1.5 mi W, 24 May 2001, *Phacelia crenulata*, B. Morgan; 1♂, Wagon Box Mesa, 1.5 mi W, 7 Jun 2001, *Cryptantha*, C.M. Davidson; 1♂, Wagon Box Mesa, 1.5 mi W, 24 May 2001, *Stanleya pinnata*, C.M. Davidson; 1♀, Water Canyon, 0.5 mi SE mouth, 25 May 2001, *Gilia inconspicua*, B. Morgan; 1♂, White Point, 2.6 mi NNE, 11 May 2003, *Streptanthus cordatus*, H. Ikerd; Grand Co., 1♂, 8–11 Jun 1967; Juab Co., 1♂, Topaz Mountain, 16 Jun 1984, C.R. Nelson; 7♂, 7♀, Topaz Mountain, 7–9 Jun 1983; 2♂, 2♀, Topaz Mountain, 7–9 Jun 1983, C.R. Nelson; Kane Co., 1♀, Butler Valley, 4.0 mi S, 12 Jun 2003, *Tamarix*, H. Ikerd; 1♂, Camp Spr., 1.5 mi SE, 12 Jun 2003, Asteraceae, S.M. Higbee; 1♀, Left Hand Collet Cyn, 1.5 mi SE, 23 May 2000, Asteraceae (white), R. Andrus, C.M. Davidson; 1♀, Left Hand Collet Cyn, 1.5 mi SE, 23 May 2000, *Opuntia*, R. Andrus, C.M. Davidson; 1♂, 1♀, Left Hand Collet Cyn, 2.7 mi SE, 4 Jun 2001, O.J. Messinger; 2♂, 1♀, Pete's Cove, 1.0 mi E, 12 Jun 2003, *Opuntia polyacantha*, C. Boyers; 2♂, 3♀, Pete's Cove, 1.0 mi E, 12 Jun 2003, *Opuntia polyacantha*, S.M. Higbee; 1♀, Water Canyon, 3.34 mi W, 29 May 2003, *Stephanomeria tenuifolia*, H. Ikerd; 2♂, Water Canyon, 3.34 mi W, 29 May 2003, *Phacelia pulchella*, S.M. Higbee; San Juan Co., 1♂, Moab, 25 mi S, 10 Jun 1963, G.E. Bohart, R.L. Brumley; Tooele Co., 1♂, Wig Mountain, 5.1 mi E, 20 Jun 2005, *Stanleya pinnata*, E. Jarrell; 1♀, Dugway Proving Grounds; Wig Mt, 3 km NE (site 37), 20 May 1998, T. Toler; 1♂, 1♀, Dugway Proving Grounds, Wig Mt., 3 km NE, 28 May 1998, T. Toler; 3♀, Dugway Proving Grounds, Wig Mt, 3.5 km E, 28 May 1998, T. Toler; Wayne Co., 1♂, 4♀, Torrey, W.W. Tanner (BBSL, BYUC, UCDC).

**Distribution:** USA. Nevada, Utah, western Colorado (1300–2200 m a.s.l.). Endemic to the Great Basin shrub steppe and Colorado Plateau shrublands ecoregions (Fig. 576). Largely sympatric with the more broadly distributed *A. atripes* in the Intermountain Region of the western USA.

**Phenology:** Late April–early July; majority of records (87%) last half of May and first half of June.

**Floral records:** ASTERACEAE: *Chaenactis* sp.; *Stephanomeria tenuifolia*; *Xylorhiza tortifolia*. BORAGINACEAE: *Cryptantha* sp.; *Phacelia crenulata*, *Phacelia fremontii*, *Phacelia pulchella*. BRASSICACEAE: *Stanleya pinnata*; *Streptanthus cordatus*. CACTACEAE: *Opuntia polyacantha*. CLEOMACEAE: *Cleome lutea*. FABACEAE: *Astragalus confertiflorus*; *Dalea searlsiae*; *Lupinus* sp.; LAMIACEAE: *Poliomintha incana*. LILIACEAE: *Calo-*

*chortus* sp. MALVACEAE: *Sphaeralcea coccinea*. POLEMONIACEAE: *Gilia inconspicua*. POLYGONACEAE: *Eriogonum umbellatum*. TAMARICACEAE: *Tamarix* sp.

**Etymology:** This species is named using the Greek suffix ‘-oides’, meaning ‘having the appearance of’ or ‘like’, referring to its resemblance to *A. atripes*.

*ANTHIDIUM* AYMARA TORO & RODRÍGUEZ, 1998

FEMALE, FIG. 55

*Anthidium aymara* Toro & Rodríguez, 1998: 67 (holotype: AMNH; ♂, Agua Verde, Región II, Chile).

**Diagnosis:** Both sexes of this species are similar to those of *A. adelphum* sp. nov. (see above). The female can be easily separated from that species by the clypeus with thicker distal margin (Fig. 55) and T6 with lateral spine distinctively yellowish, translucent, and with distal margin medially projecting; the male can be distinguished by T7 with lateral lobe slightly curved medially at apex, and S6 with small lateral spine and distal margin medially concave. Also, F1 is less than twice as long as broad, and the basal three terga have broader lateral bands, not deeply emarginated or notched on their posterior margins, as in the female of *A. adelphum* sp. nov.

**Description:** *Female.* Body length 12.0–13.0 mm; forewing length 9.1–9.9 mm. **Structure.** Clypeus weakly convex, projected about 0.5× width of compound eye in profile, distal margin thick, gently concave between lateral tubercles (Fig. 55); mandible with six or seven teeth; labrum without basal protuberances, preapical projections small, indicated by elevated border on lateral margin of furrow; F1 1.7× longer than broad, shorter than combined lengths of F2 and F3. Tibial carina absent. T6 convex in profile, distinctly depressed medially, lateral spine distinct, curved, distal margin medially projecting, median emargination reduced or absent. **Coloration.** Dark brown to black, except yellow maculations as follows: outer surface of mandible basally, apical third of clypeus, rounded to oval spot laterally on vertex, tegula (usually reduced or absent), and T1–T5 with medially interrupted bands, laterally weakly emarginate on posterior margin of T1; ferruginous on pronotal lobe (sometimes absent), antenna (darkened on anterior surface of flagellomeres), tegula, legs excluding coxae, trochanters, and bases of femora, and lateral spine of T6. Wings light orange basally, brownish distally; veins ferruginous basally, dark brown distally, including stigma. **Pubescence.** Whitish, except ferruginous hairs on inner surface of tarsi; dark brown to black hairs on depressed marginal



zones of T1–T4 and entire surface of remaining terga; metasomal scopa mostly light brown, pale laterally when seen in profile. Outer surface of fore and mid basitarsi sparsely covered with some pale tomentum, denser on fore basitarsus (integument visible among hairs). *Sculpturing*. Propodeal triangle weakly shiny, weakly imbricate. T1–T5 with weakly elevated discal areas, shiny, weakly lineolate or imbricate, sparsely punctate (2–3× PW); depressed marginal zones slightly denser than on discs (1–2× PW); distal margins dull, little or not differentiated from rest of depressed marginal zone, about one-quarter of punctate depressed marginal zone.

*Male*. Body length 13.8–15 mm; forewing length 9.7–11 mm. *Structure*. F1 1.5× longer than broad, shorter (0.6×) than combined lengths of F2 and F3. Lateral spine of T6 gently curved, about as long as median spine of T7; lateral lobe of T7 elongate, with apex slightly curved medially; S6, in ventral view, with basal margin strongly biconvex, lateral spine small, laterally oriented, distal margin medially concave; S4, S7, S8, and genital capsule as in *A. adelphum* sp. nov. *Coloration*. As in female, except clypeus and inferior paraocular area entirely yellow and lateral bands on T1–T3 (sometimes also T4) more deeply emarginate on posterior margins. *Pubescence*. Sterna with mostly whitish hairs. *Sculpturing*. Terga smoother, shinier than in female, particularly on T6.

*Distribution*: CHILE: Arica and Parinacota, Antofagasta, Atacama (1400–3100 m a.s.l.). Found in the Atacama Desert and Central Andean dry puna ecoregions.

*Phenology*: September–November, February.

*Comments*: The illustrations of the mandible, T6, and S6 of the female, as well as the mandible, T7, S5–S8, and genitalia of the male of *A. aymara* in Toro & Rodríguez (1998) do not correspond to this species. The illustrated structures are those of *A. adelphum* sp. nov., the closely related species described in this paper. Among the type specimens of *A. aymara* at the AMNH, we found two small vials attached to a single pin containing these structures, including those of *A. aymara*. Except for the identification label (as *A. aymara*), neither collecting data nor bee specimens are associated with these vials. Such a mistake in the illustrations of *A. aymara* do not require any taxonomic action because the description as well as the label data, except for the date (16-X-86 in the specimen label and 28-X-1993), agree with the holotype.

#### ANTHIDIUM AZTECUM CRESSON, 1878

FEMALE, FIGS 56, 136; MALE, FIGS 215, 287, 340, 417, 493; MAP, FIG. 576

*Anthidium aztecum* Cresson, 1878: 109 (lectotype: ANSP 2383; ♀, Mexico); Cresson, 1916: 113 (lectotype designation).

*Diagnosis*: This species shares with *A. hallinani*, *A. macushi* sp. nov., and *A. sanguinicaudum* the terga dull, finely and densely punctate, with discal areas weakly elevated (as in Fig. 26). As in *A. hallinani*, female T6 lacks the acute lateral projection found in *A. macushi* sp. nov. and *A. sanguinicaudum* (compare Figs 136 and 172), male S6 is not apically projected into a short, ventrally directed spine (Fig. 340), and the apical process of S8 is not apically broad (Fig. 493). Unlike *A. hallinani*, the depressed apical rim of female T6 in *A. aztecum* is visible for almost its entire length (in dorsal view), and lacks the short carina above the median emargination (Fig. 136); in the male, the reddish brown brush of S4 is about one-third of the sternal width (Fig. 287), and the lateral lobe of S6 is sharply projected (Fig. 340). In the female of *A. hallinani*, the depressed apical rim of T6 is only visible medially, and the carina above the median emargination is present (Fig. 161); in the male, the apical brush of S4 is broader and more developed (Fig. 305), and the lateral lobe of S6 is not as sharp as in *A. aztecum* (Fig. 365).

*Description*: *Female*. Body length 10.0–12.2 mm; forewing length 7.2–7.7 mm. *Structure*. Clypeus prominently convex, projected about 0.4× width of compound eye, distal margin straight, sometimes gently tuberculate (Fig. 56); mandible with seven teeth; labrum without basal protuberances, gently swollen laterally on base, preapical projections barely indicated by elevated border on lateral margin of furrow; F1 1.7× longer than broad, slightly shorter (–0.8–0.9×) than combined lengths of F2 and F3. Tibial carina present. T6 nearly straight in profile, disc gently swollen above narrow median emargination, distal margin somewhat truncate, depressed apical rim projecting across two-thirds of distal margin (Fig. 136). *Coloration*. Dark reddish brown to black, except yellow maculations as follows: outer surface of mandible, distal half of clypeus except medially (sometimes broadly interrupted), inferior paraocular area, rounded to oval spot laterally on vertex (sometimes reduced or absent), pronotal lobe (sometimes absent), anterior margin of tegula, anterolateral and lateral margins of scutum with continuous broad band (sometimes reduced), axilla (sometimes reduced or absent), distal margin of scutellum, outer surfaces of tibiae basally, T1 and T2

with medially interrupted bands (sometimes with four widely separated spots), T3–T5 with entire band, laterally notched on anterior margin, sometimes medially interrupted on T3, and T6 entirely, except lateral and distal margins. Wings hyaline, slightly brownish; veins and stigma dark brown. *Pubescence*. Whitish except brownish to light ferruginous hairs on vertex, disc of scutum, inner surface of tarsi, terga, and S6. Outer surface of basitarsi densely covered by tomentum (integument not visible between hairs). *Sculpturing*. Propodeal triangle minutely punctate, dull. T1–T5 with weakly elevated discal areas, dull, weakly imbricate between dense punctures (1–2× PW); depressed marginal zones slightly more densely punctate than discs ( $\leq 1\times$  PW); distal margins dull, narrow (2–3× PW).

*Male*. Body length 11.1–12.3 mm; forewing length 7.2–7.8 mm. *Structure*. F1 1.4× longer than broad, shorter (0.7×) than combined lengths of F2 and F3. Lateral spine of T6 straight, short, about as long as median spine of T7; lateral lobe of T7 broadly rounded, slightly obliquely truncate on distal margin, more than twice as broad as distance between inner margin and median spine, outer margin slightly convex, inner margin straight (Fig. 215); S4 with distal margin gently emarginate to nearly straight, apical brush with two or three rows of thick, reddish brown hairs on median one-third (Fig. 287); S6, in ventral view, with gently convex basal margin, laterally with sharp, ventrolaterally directed spine, distal margin broadly convex, median portion (as seen in ventral view) thickened, narrowly truncate, gently concave in posterior view (Fig. 340); S7 hemisternite as in Figure 417; S8 with apical process straight in profile, pointed, weakly bifid apically, about one-third width of distal margin basally (Fig. 493). Genitalia: gonostylus slender, about 6.0× longer than broad; volsella broad, elongate, about two-thirds of gonostylar length, ventroapically projected, partially covering penis valves, dorsally with small basal protuberance; penis valve about as long as gonostylus, narrow, blade-like, apically pointed, medially curved, dorsoapical patch of hairs absent, medial projection large, distinct. *Coloration*. As in female except yellow maculations as follows: clypeus, anterior surface of scape, anterior surfaces of F2 and F3 (reduced or absent), anterior and lateral margins of scutum (often reduced), inferior surfaces of fore and mid femora distally, outer surfaces of fore and mid tibiae, tarsi, and T6 and T7 entirely; T1 and T2 with four widely separated bands. *Sculpturing*. Terga somewhat shinier, with sparser punctures than in female.

*Distribution*: MEXICO: central states of Jalisco, Michoacán, and Oaxaca (100–200 m a.s.l.). Known only from dry forest ecoregions on the Pacific slope (Fig. 576).

*Phenology*: August–early November.

*ANTHIDIUM BANNINGENSE* COCKERELL, 1904

FEMALE, FIGS 12, 13, 33, 57, 137; MALE, FIGS 216, 288, 341, 418, 494; MAP: 577

*Anthidium banningense* Cockerell, 1904b: 58 (holotype: USNM 58046; ♂, Banning, California, USA).

*Anthidium plumarium* Cockerell, 1925a: 356 (holotype: CAS 1736; ♂, Meadow Valley, Plumas Co., California, USA); Timberlake in Michener, 1951: 1139 (synonymy with *banningense*).

*Anthidium longispinum* Schwarz, 1927b: 6 (holotype: USNM 40163; ♀, San Bernardino Co., California, USA); Schwarz, 1928: 390 (synonymy with *banningense*).

*Diagnosis*: The female can be easily recognized by T6 with long, acute lateral angle (Fig. 137) and the terga densely punctate. The male can be recognized by T7 with nearly digitiform lateral lobe (Fig. 216), S6 with lateral lobe distinctly obliquely truncate, thus forming sharp lateral and submedian angles or spines, and median lobe rectangular, apically truncate (Fig. 341).

*Description: Female*. Body length 9.2–12.3 mm; forewing length 7.0–8.7 mm. *Structure*. Clypeus prominently convex, projected about 0.6× width of compound eye in profile, distal margin thin, gently tuberculate, two lateralmost tubercles usually more distinctly projected (Fig. 57); mandible with six teeth; labrum without basal protuberances, preapical projections large, distinctly curved upwards (Figs 12, 13); F1 1.7× longer than broad, shorter (0.8×) than combined lengths of F2 and F3. Tibial carina absent. T6 gently convex in profile, somewhat flattened apically, preapical carina absent, distal margin convex between acute, medially oriented lateral projections (Fig. 137). *Coloration*. Dark reddish brown to black, except ivory or yellow maculations as follows: rounded to oval spot laterally on vertex, pronotal lobe, anterior third of tegula, axilla, distal half of scutellum except medially, T1–T5 with entire, medially narrowed bands, laterally notched on anterior margin (often weakly interrupted medially or broken into four bands or spots on T1 and T2), and T6 usually with medially interrupted band (sometimes reduced to two large spots). Wings hyaline, slightly brownish; veins and stigma dark brown. *Pubescence*. Whitish, except brown to ferruginous hairs on vertex, scutum, scutellum, axilla, inner surfaces of tarsi, and centre of S6. Outer surfaces of basitarsi densely covered by tomentum (integument not visible among hairs), slightly sparser on hind basitarsus. *Sculpturing*. Propodeal triangle nearly smooth, shiny, finely and

weakly lineolate. T1–T5 with weakly elevated discal areas, densely punctate (1–2× PW), punctures continuing into weak grooves distally, smooth, shiny between punctures; depressed marginal zones with punctures nearly contiguous; distal margins narrow (1–2× PW).

**Male.** Body length 12.3–14.6 mm; forewing length 9.2–10.2 mm. **Structure.** F1 1.3× longer than broad, shorter (0.6×) than combined lengths of F2 and F3; preapical labral projections longer than in female. Lateral spine of T6 gently curved, longer than median spine of T7; lateral lobe of T7 narrow, elongate, nearly digitiform (Fig. 216); S4 with broad (~0.4× sternal width), dense, long, apical brush of black hairs consisting of two brushes: a preapical concave brush and a straight apical brush of shorter hairs on weakly concave to nearly straight distal margin (Fig. 288); S6, in ventral view, with gently convex basal margin, laterally obliquely truncate, forming a sharp lateral and submedian angle, median lobe rectangular (Fig. 341); S7 hemisternite with oblique, sinuous distal margin (Fig. 418); S8 with apical process short, broader than long, weakly bifid distally, about one-third of distal margin (Fig. 494). Genitalia: gonostylus robust, about three times longer than broad; volsella small, about one-fifth of gonostylar length, rectangular, dorsally projected; penis valve shorter (0.4×) than gonostylus, dorsoapical patch of hairs present, medial projection small. **Coloration.** As in female, except: black on axilla, scutellum, and T7; yellow or cream on clypeus, except for apical margin and basal third, inferior paraocular area, outer surfaces of tibiae distally (sometimes absent on hind tibia), and tarsi; T6 usually with two diffuse spots on disc. **Sculpturing.** T1–T5 with finer, sparser punctures than in female.

**Distribution:** USA: montane California (800–2900 m a.s.l.), but largely absent from the North and South Coast Ranges; valleys and lower margins of the mountains in the Intermountain Region of Washington, Oregon, Idaho, Nevada, and northern Utah (70–2700 m a.s.l.); found in forest, woodland, chaparral, and grassland ecoregions. Anomalous record from west Texas (Fig. 577).

**Phenology:** May–August; most records (89%) in June and July.

**Floral records:** Majority of visits (781%) to *Phacelia*. ALLIACEAE: *Allium* sp. ASTERACEAE: *Chaenactis glabriuscula*. BORAGINACEAE: *Cryptantha* sp.; *Nama hispidum*; *Phacelia hastata*, *Phacelia heterophylla*, *Phacelia imbricata*, *Phacelia leucophylla*\*, *Phacelia linearis*, *Phacelia mutabilis*, *Phacelia ramosissima*.

FABACEAE: *Lotus davidsonii*; *Medicago sativa*; *Psoralea lanceolata*; *Trifolium wormskioldii*. ONAGRACEAE: *Clarkia amoena*, *Gayophytum* sp. PLANTAGINACEAE: *Collinsia heterophylla*; *Penstemon* sp. ROSACEAE: *Physocarpus* sp.

**Biology:** Nests are constructed in the ground (Jaycox, 1967b). Males exhibit a well-developed territorial behaviour based on preferred host plants, such as that observed in *A. manicatum* (Jaycox, 1967b).

#### ANTHIDIUM CAFAYATE SP. NOV.

##### FEMALE, FIG 5C

**Diagnosis:** Both sexes of this species can be distinguished from all other South American *Anthidium*, except *A. calchaqui* sp. nov. and *A. kolla* sp. nov., by the following characters: clypeus, supraclypeal area, and frons sparsely covered with stiff, simple, apically curly or hooked hairs (Fig. 5B–D); body size ( $\leq 11$  mm in body length); coloration (i.e. antenna, tegula, legs, and base of wings ferruginous, and T1–T4 with interrupted yellow or cream bands); hind tibia with longitudinal carina; and male S6 with distal margin emarginate medially. The female can be easily separated from those species by the following combination of characters: face somewhat flattened; frons sparsely punctate (1–2× PW), with modified integument and hairs not or little extending beyond median ocellus and lateral tangent of lateral ocellus (Fig. 5C); T1–T4 with narrowly interrupted bands (gap between bands much shorter than half length of lateral band); and sternal scopa black. In *A. kolla* sp. nov. the face is not flattened, the clypeus is distinctly convex and the frons is more densely punctate ( $\leq 1\times$  PW). In *A. calchaqui* sp. nov. the face is distinctly flattened, nearly depressed in profile, the frons is as sparsely punctate as in *A. cafayate* sp. nov., but with the modified integument and hairs extending well beyond median ocellus and lateral tangent of lateral ocellus, T1 lacks maculations, T2–T4 have more broadly interrupted bands (gap between bands more than length of lateral band), and the sternal scopa is laterally whitish (best seen in profile). The male can be recognized by the following combination of characters: frons as in the female, T7 with short lateral lobe (at most about as long as broad) and median spine reaching apex of lateral lobe, and S6 with shallow median emargination on distal margin (~5× broader than deep).

**Description: Female.** Body length 10.9 mm; forewing length 8.8 mm. **Structure.** Face somewhat flattened, particularly supraclypeus and frons; clypeus with distal margin thin, wavy, sublaterally projected (Fig. 5C); mandible with six teeth (right mandible



with apices of second, fourth, and fifth teeth broken off); labrum with low basal protuberances separated by more than width of protuberance, preapical projections large, distinctly curved upwards; F1 2.2× longer than broad, slightly longer than combined lengths of F2 and F3. Tibial carina present. T6 with disc gently swollen midapically, without distinct lateral angle, distal margin truncate, depressed apical rim visible on about median one-quarter of distal margin. *Coloration*. Black, except yellow maculations, as follows: oval spot laterally on vertex, T1–T4 with medially interrupted bands, T5 with entire band medially notched on anterior margin; ferruginous on: antenna, tegula, apices of femora, and remaining segments of legs. Wings light orange basally, brownish distally, with weak coppery and violet reflections; veins ferruginous basally, including prestigma, dark brown distally. *Pubescence*. Black, except ferruginous hairs on ferruginous areas of body, excluding scape; darker hairs intermingled with ferruginous hairs on outer surfaces of femora. Clypeus, supraclypeal area, and frons covered with simple, stiff, apically curly or hooked hairs, denser on clypeus. Outer surfaces of fore and mid basitarsi densely covered by tomentum (integument not visible among hairs). *Sculpturing*. Supraclypeal area and frons dull between coarse, sparse (1–2× PW) punctures, integument finely imbricate, clypeus shinier, with punctures small, contiguous as on paraocular area. Propodeal triangle finely lineolate, weakly shiny. T1–T5 with weakly elevated discal areas, shiny, faintly imbricate–lineolate between coarse, sparse punctures (1–3× PW); depressed marginal zones more densely punctate than on discs ( $\leq 1\times$  PW); distal margins smooth, shiny, narrow (1–2× PW); T6 coarsely, densely punctate ( $\leq 1\times$  PW), most punctures continuing into grooves distally.

*Male*. Body length 12.3–13.8 mm; forewing length 9.2–10.0 mm. *Structure*. F1 1.8× longer than broad, shorter ( $\sim 0.8\times$ ) than combined lengths of F2 and F3; preapical labral projections absent. Lateral spine of T6 gently curved, about as long as median spine of T7; lateral lobe of T7 about as long as broad, wider ( $\sim 1.7\times$ ) than distance between inner margin and median spine, outer margin nearly straight, inner margin angled; S4 with dense, black hair brush on median one-sixth of straight distal margin; S6, in ventral view, gently projecting medially on basal margin, laterally with small projection (visible after dissection), distal margin with strong sublateral lobe, medially with shallow emargination, about five times broader than deep; S7 hemisternite distally truncate (as in Fig. 426); S8, in ventral view, with narrow apical process, about one-third width of distal margin basally, apex of apical process laterally compressed, broad. Genitalia: gonostylus about twice as long as

broad; volsella about three-quarters of gonostylar length; penis valve shorter than gonostylus, apically narrow, pointed, dorsoapical patch of hairs absent, medial projection large, distinct. *Coloration*. As in female, except scape basally (absent in one paratype) and distal flagellomeres (entire flagellum, except basal three segments in one paratype) darkened on anterior surface, lateral bands on T1–T5 more widely separated, and yellow or ivory on outer surface of mandible basally, clypeus (except apical margin), and inferior paraocular area. *Pubescence*. As in female, except whitish hairs on clypeus, paraocular area, scape, mesepisternum and metanotum laterally, posterodistal margin of hind tibia, and posterior margin of hind basitarsus; whitish hairs intermingled with black hairs on vertex, scutum, axilla, scutellum, and discs of T1 and T2 (also on T3 and T4 in one paratype). *Sculpturing*. Terga shinier, distal margins broader than in female.

*Holotype*: ♀, ARGENTINA: Salta, Alt. de Tastil, 3100 m a.s.l., Fritz-3.96 (March, 1996) (AMNH).

*Paratypes*: 3 males. ARGENTINA: Salta, 1♂, same data as holotype; 1♂, Alturas Amblayo, 3600 m a.s.l., Mar 1993, Fritz; 1♂, El Alisal, Apr 1994, Fritz (AMNH, BBSL).

*Distribution*: ARGENTINA: Salta at higher elevations (3100–3600 m a.s.l.) in southern part of the state. Recorded from the Central Andean puna, High Monte, and Southern Andean Yungas ecoregions.

*Phenology*: March, April.

*Etymology*: This species is named after the Cafayate people who inhabited the province of Salta, northern Argentina, prior to the Spanish Conquistadores.

#### *ANTHIDIUM CALCHAQUI* SP. NOV.

FEMALE, FIG. 5D

*Diagnosis*: Both sexes of this species constitute a distinctive group with those of *A. cafayate* sp. nov. and *A. kolla* sp. nov. (see above). The female is easily separated from those species by the following combination of characters: face distinctly flattened, nearly depressed in profile; frons with modified integument and hairs extending well beyond median ocellus and lateral tangent of lateral ocellus (Fig. 5D); T1 immaculate, T2–T4 with more broadly interrupted bands (gap between bands more than length of lateral band); and sternal scopa whitish laterally (best seen in profile). The male can be distinguished from those species by the following combination of characters: frons as in the female; T7 with lateral lobe short, at

most about as long as broad, and median spine long, reaching apex of lateral lobe; and S6 with deep median emargination on distal margin ( $\sim 3\times$  broader than deep).

*Description: Female.* Body length 11.1 mm. *Structure.* Face distinctly flattened, nearly depressed in profile; clypeus with distal margin thin, sublaterally projected (Fig. 5D); mandible with seven teeth; labrum with low basal protuberances separated by more than width of protuberance, preapical projections large, distinctly curved upwards; F1  $1.9\times$  longer than broad, slightly shorter ( $0.9\times$ ) than combined lengths of F2 and F3. Tibial carina present. T6 with disc gently swollen midapically, without distinct lateral angle, distal margin truncate, depressed apical rim visible on about median one-quarter of distal margin. *Coloration.* Black, except yellow maculations as follows: small oval spot laterally on vertex, T2–T5 with short lateral bands, closest on T5; ferruginous on: antenna (darker on distal flagellomeres), tegula, apices of femora, and remaining segments of legs. Wings light orange basally, brownish distally, with weak coppery and violet reflections; veins ferruginous basally, including prestigma, dark brown distally. *Pubescence.* Whitish, except dark brown to black hairs on vertex, discs of scutum, axilla, and scutellum, mesepisternum ventrally, coxae, trochanters, bases of femora, discs of T2–T6, and scopa, except sides of S2–S4. Clypeus, supraclypeal area, and frons covered with simple, stiff, apically curly or hooked hairs, denser on clypeus. Outer surfaces of fore and mid basitarsi densely covered by tomentum (integument not visible among hairs). *Sculpturing.* Supraclypeal area and frons shagreened between coarse, sparse ( $1\text{--}2\times$  PW) punctures, integument finely imbricate, clypeus shinier, with punctures small, contiguous as on paraocular area. Propodeal triangle finely lineolate, weakly shiny. T1–T5 with weakly elevated discal areas, smooth and shiny, nearly glossy between coarse, sparse punctures ( $2\text{--}3\times$  PW); depressed marginal zones more densely punctate than on discs ( $\leq 1\times$  PW); distal margins smooth, shiny, narrow ( $1\text{--}2\times$  PW); T6 coarsely, densely punctate ( $\leq 1\times$  PW), most punctures continuing into grooves distally.

*Male.* Body length 10.0–12.3 mm; forewing length 7.4–9.4 mm. *Structure.* F1  $1.9\times$  longer than broad, shorter ( $\sim 0.7\times$ ) than combined lengths of F2 and F3; preapical labral projections absent. Lateral spine of T6 gently curved, about as long as median spine of T7; lateral lobe of T7 slightly broader than long basally, wider ( $\sim 1.5\times$ ) than distance between inner margin and median spine, outer margin nearly straight, inner margin angled; S4 with dense, black hair brush on median one-sixth of straight distal margin; S6, in ventral view, with basal margin

straight or nearly straight, laterally with small projection (visible after dissection), distal margin with strong sublateral lobe, medially with deep emargination, about  $3.5\times$  broader than deep; S7 hemisternite distally truncate (as in Fig. 426); S8, in ventral view, with narrow apical process, about one-third width of distal margin basally, apex of apical process laterally compressed, broad. Genitalia: gonostylus nearly  $3.0\times$  longer than broad; volsella about three-quarters of gonostylar length; penis valve shorter than gonostylus, apically narrow, pointed, dorsoapical patch of hairs absent, medial projection large, distinct. *Coloration.* As in female except scape basally and distal flagellomeres darkened on anterior surface, lateral bands on T1–T5 more widely separated, and yellow or ivory on outer surface of mandible basally, inferior paraocular area, and clypeus, except apical margin and inverted V-shaped black spot basally. *Pubescence.* As in female, except whitish hairs on clypeus, paraocular area, scape, discs of T1–T4, and S1–S3; whitish hairs intermingled with black hairs on vertex, scutum, axilla, and scutellum. *Sculpturing.* Terga shinier, distal margins broader than in female.

*Holotype:* ♀, ARGENTINA: Salta, El Alisal, Fritz-4.94 (April of 1994) (AMNH).

*Paratypes:* 5 males. ARGENTINA: Salta, ♂, Chorillo, Mar 1993, Fritz; 1♂, El Alisal, Apr 1990, Fritz; 1♂, El Alisal, Mar 1993, Fritz; 1♂, El Alisal, Mar 1996, Fritz; 1♂, Yacechura, c. Cafayete, 25 Apr 1971, C. Porter (AMNH, BBSL, FSCA).

*Distribution:* ARGENTINA: Salta, Catamarca (1900–4200 m a.s.l.). Recorded from the ecoregions of High Monte, Southern Andean Yugas, and Central Andean Puna.

*Phenology:* February–April.

*Etymology:* This species is named after the Calchaquí people, who formerly occupied the province of Salta, in northern Argentina. The novelty of this species was recognized by Dr. Lionel A. Stange, who intended to name it after the Calchaquí. We retained this designation.

*Comments:* Two males with the following label data, deposited at FSCA, were not designated as paratypes because of their poor condition (head and terminal sterna are missing): Argentina, Salta, Yacochuya, 9 km NO de Cafayete, 23–26.IV.1970, L. Stange–C. Porter; Catamarca, C. Minus Capillitas, J.L. Neff, 28.II.1973.

***ANTHIDIUM CHAMELENSE* SP. NOV.**

FEMALE, FIGS 58, 138; MALE, FIGS 39, 217, 342, 419, 495, 565; MAP, FIG. 577

*Diagnosis:* Both sexes of this species can be distinguished from all other NW *Anthidium* except *A. rodriguezi* by their large size (body length > 16 mm) and metasoma all black, contrasting with scutellum and axillae entirely yellow. It can be easily separated from *A. rodriguezi* by the female T6 with lateral angle rounded and preapical carina with semicircular emargination narrow (Fig. 138), male T6 with lateral spine acute, and male T7 with median spine blunt (Fig. 217).

*Description (paratypes in parentheses): Female.* Body length 16.9 mm (16.2–20.0); forewing length 12.3 mm (12.0–14.6). *Structure.* Compound eyes slightly convergent below, nearly parallel-sided (as in Fig. 5E); face flat; clypeus with distal margin straight (Fig. 58); mandible elongate with seven or eight teeth (as in Fig. 8); labrum with basal protuberances separated by less than width of protuberance, preapical projections absent; F1 2.0× longer than broad, shorter (0.8×) than combined lengths of F2 and F3. Tibial carina present. T6 convex laterally, flattened above preapical carina, lateral angle rounded, preapical carina strong, broadly emarginate on median third, depressed apical rim with small median emargination (Fig. 138). *Coloration.* Black, (except dark brown on antenna and fore and mid tibiae); yellow maculations as follows: apicolateral corners of clypeus, broad (~OD), (medially interrupted) band on vertex, axilla and scutellum entirely, pronotal lobe with diffuse spot (absent). Wings brown; veins and stigma dark brown. *Pubescence.* Whitish, except dark brown to black hairs on clypeus, supraclypeal area, vertex, disc of scutum, coxae, trochanters, outer surface of mid basitarsus except basally, inner surfaces of tarsi, and terga, except T6; sternal scopa whitish laterally, brownish otherwise. Clypeus, supraclypeal area, and frons covered with simple, stiff, apically curly or hooked hairs, denser on clypeus. Outer surfaces of basitarsi densely covered by tomentum, integument not visible among hairs. Terga with short ( $\leq$  OD), sparse hairs barely visible in profile, longer and denser on T6. *Sculpturing.* Clypeus, supraclypeal area, and frons dull between coarse, sparse (1–2× PW) punctures, integument finely imbricate, punctures smaller, closer on clypeus. Propodeal triangle dull, finely punctate. T1–T5 with weakly elevated discal areas, shiny, weakly imbricate to nearly smooth between dense punctures (1–2× PW); depressed marginal zones laterally punctate (~1× PW), punctures otherwise sparse or absent; distal margins little or not differentiated from rest of

depressed marginal zone, about as wide as depressed marginal zone laterally.

*Male.* Body length 18.5–21.5 mm; forewing length 15.1–16.2 mm. *Structure.* Face nearly as flat as in the female, except clypeus weakly convex; mandible elongate, with three large, distinct teeth, distance between second and third teeth about twice as long as distance between first and second, upper mandibular interspace sometimes divided in smaller teeth, thus forming six- or seven-toothed mandible; labrum with basal protuberances low, nearly absent; F1 1.7× longer than broad, shorter (0.7×) than combined lengths of F2 and F3. Hind coxa ventrally depressed; hind femur with basal tubercle on ventral surface. Lateral spine of T6 ventrally curved, shorter than median spine of T7, barely visible in dorsal view; T7 with lateral lobe spiniform, about twice as long as median spine (Fig. 217); S4 gently convex on distal margin, apical hair brush absent; S6, in ventral view, with basal margin straight, distal margin strongly reflexed, with distinct, long, acute lateral and median lobes (Fig. 342); S7 hemisternite narrowly projected distally (Fig. 419); S8 elongate (2.8× longer than broad) with apical process longer than broad, weakly bifid distally (Fig. 495). Genitalia (Fig. 565): gonostylus slender, 5.0× longer than broad; volsella about one-third of gonostylar length, digitiform (in profile view), ventrally curved, about as wide as apex of penis valve; penis valve about half of gonostylar length, apically curved, with large dorsolateral projection (better seen in profile view), dorsoapical patch of hairs present, medial projection distinct. *Coloration.* As in female, except yellow maculations as follows: outer surface of mandible, clypeus except distal margin and basal half (sometimes entirely yellow with two small basal dark spots), inferior paraocular area, pronotal lobe (usually reduced), outer surface of middle tibia distally (extending along anterior half in one paratype), outer surfaces of basitarsi, and small spot laterally on T1 (absent in one paratype). *Pubescence.* As in female, except normal, shorter, sparser whitish hairs on clypeus, supraclypeal area, and frons. Ventral surfaces of mesepisternum, metepisternum, and base of hind coxa densely covered by short, stout, simple, dark-brown hairs, longer, denser on metepisternum (Fig. 39). Outer surface of fore basitarsus barely covered by tomentum. *Sculpturing.* Clypeus and discal areas of T1–T6 more densely, finely punctate than in female.

*Holotype:* ♀, MEXICO: Jalisco, Chamela (Est. Biol.), 4-XI-[19]87, T. Griswold (BBSL).

*Paratypes:* 7 females, 6 males. MEXICO: Guerrero, 1♂, Iguala, 22 mi S, 18 Aug 1981, J. Chemsak, A.&M.



Michelbacher; 1♀, Iguala, 30 mi S, 18 Aug 1981, J. Chemsak, A.&M. Michelbacher; Jalisco, 1♀, Chamela, 7 Oct 1985, A.P. Rodriguez; 1♀, Chamela, 1–8 Oct 1985, F.D. Parker, T.L. Griswold; 1♀, Chamela (Est. Biol.), 25 Sep 1985, C.D. Michener; 4♂, Chamela (Est. Biol.), 4 Nov 1987, T.L. Griswold; 1♀, Chamela, Est. Biol., 6 Oct 1985, J.G. Rozen; Oaxaca, 1♀, Oaxaca, 45 mi SE, 13 Jul 1952, E.E. Gilbert, C.D. MacNeil; 1♂, Tehuantepec, 12 mi W, 16 Sep 1974, G. Bohart, W. Hanson; 1♀, Tehuantepec, 35 mi W, 16 Sep 1974, W. Hanson, G. Bohart (AMNH, BBSL, EBCC, EMEC, SEMC).

*Distribution:* MEXICO: Guerrero, Jalisco, and Oaxaca (50–1300 m a.s.l.). Apparently restricted to dry forest and pine-oak forest ecoregions (Fig. 577). Appears more restricted in distribution than the closely related *A. rodriguezi*.

*Phenology:* July–November.

*Etymology:* The specific epithet is derived from the field station where most of the specimens of this species were collected: Estación de Biología Chamela.

#### *ANTHIDIUM CHILENSE* SPINOLA, 1851

FEMALE, FIGS 59, 139; MALE, FIGS 218, 343, 420, 496; MAP, FIG. 583

*Anthidium chilense* Spinola, 1851: 181 (lectotype: MSNT; ♀, Santa Rosa, Coquimbo, Chile) (**new lectotype designation**).

*Diagnosis:* The female can be recognized by the following combination of characters: small body size (8–10 mm); clypeus and inferior paraocular area pale (Fig. 59); hind tibia without carina; basitarsi with outer surfaces densely covered by white tomentum; and sternal scopa predominantly white. The male can be distinguished from all NW *Anthidium* by T7 with lateral lobe spiniform and median spine short, blunt, as least as wide as the apex of the lateral lobe (Fig. 218).

*Description: Female.* Body length 8.4–10.0 mm; forewing length 6.4–7.1 mm. *Structure.* Clypeus prominently convex, projected about 0.4× width of compound eye in profile, distal margin thin, usually wavy or gently tuberculate (Fig. 59); mandible with six teeth; labrum with low basal protuberances, separated by about width of protuberance, preapical projections large, distinctly curved upwards; F1 1.4× longer than broad, shorter (0.7×) than combined lengths of F2 and F3. Tibial carina absent. T6 gently convex in profile, without distinct lateral angle,

preapical carina minutely crenulate, depressed apical rim slightly bent dorsally, projecting across median one-third of distal margin (Fig. 139). *Coloration.* Black, except cream or yellow maculation as follows: outer surface of mandible (sometimes absent), clypeus, inferior paraocular area, rounded to oval spot laterally on vertex, anterolateral margin of scutum, axilla (usually absent), distal half of scutellum, except medially, T1–T4 with medially interrupted bands, laterally weakly notched on posterior margin, T5 with complete band, medially notched on anterior margin, and T6 laterally; ferruginous on antenna (darker apically), pronotal lobe (sometimes entirely black), tegula, and legs, except dark-brown coxae, trochanters, and bases of femora. Wings light orange basally, brownish distally; veins ferruginous basally (including stigma and prestigma), dark brown distally. *Pubescence.* Whitish, except yellowish to brownish hairs on frons, vertex, pronotal lobe, scutum, axilla, scutellum, inner surfaces of tarsi, and S6; dark-brown to black hairs on depressed marginal zones of T1–T4, T5 and T6 entirely, and sides of S2–S5. Clypeus sparsely covered with apically curved hairs. Outer surfaces of basitarsi densely covered by tomentum (integument not visible among hairs). *Sculpturing.* Propodeal triangle weakly shiny, finely imbricate. T1–T5 with weakly elevated discal areas, shiny, weakly lineolate or imbricate, nearly smooth between punctures (2–4× PW); depressed marginal zones more densely punctate than on discs (1–2× PW); distal margins dull, narrow (1–2× PW), little differentiated from depressed marginal zone, broadest on T5.

*Male.* Body length 10.0–12.3 mm; forewing length 6.9–9.2 mm. *Structure.* Labrum transversely elevated basally, without preapical projections; F1 1.6× longer than broad, shorter (0.6×) than combined lengths of F2 and F3. Lateral spine of T6 gently curved, longer than median spine of T7; T7 with lateral lobe spiniform, straight or distally curved, median spine distinctly short, blunt, at least as wide as apex of lateral lobe (Fig. 218); S4 without apical brush, distal margin straight; S6, in ventral view, with basal margin gently convex to nearly straight, laterally with small, sharp projection, distal margin gently convex, somewhat truncate medially (Fig. 343); S7 hemisternite somewhat apically truncate (Fig. 420); S8 with narrow, rectangular apical process, basally broad, about one-quarter width of distal margin basally (Fig. 496). Genitalia: gonostylus robust, 2.0× longer than broad; volsella large, about half of gonostylar length, pointed in profile; penis valve about as long as gonostylus, broad, apically ending in hooked projection, dorsoapical patch of hairs absent, medial projection large, distinct. *Coloration.* As in female except yellow maculations as follows: outer surface of mandible,

basitarsi, T1 laterally, and T7 entirely, except on margins and median spine; scutellum often with reduced maculations. *Pubescence*. Sterna with brownish hairs. *Sculpturing*. Terga with broader distal margins than in female, about half width of depressed marginal zone.

*Distribution*. ARGENTINA: Chubut, La Rioja, Neuquén. CHILE: Antofagasta to Los Lagos (0–3600 m a.s.l.). Found in the Southern Andean and Patagonian steppes, Valdivian temperate forests, and Chilean matorral ecoregions (Fig. 583).

*Phenology*: September–April, June, July; most records (91%) from October through January.

*Floral records*: ASTERACEAE: *Senecio* sp. PLANTAGINACEAE: *Stemodia* sp.

*Comments*: Spinola described this species based on both males and females; he mentioned that this species is found ‘in the north (of Chile), in Santa Rosa, Coquimbo, etc.’ Spinola’s specimens are deposited in the Spinola collection of the MSNT, drawer 123. We examined a female from that collection and here designate it lectotype to stabilize the name; the only male from that series is in poor condition (G. Pagliano, pers. comm. 2009). The label data for the lectotype specimen are as follows: ‘♀//Lectotype *chilensis* Spinola J.S. Moure 1938 (numbers are handwritten and could be 1958) // red label (no writing on it) // Museo di Zoologia della Universita Torino-Italia // Lectotype *Anthidium chilense* Spinola des. V.H. Gonzalez & T. Griswold 2009’.

The width of the lateral lobe as well as the middle spine of T7 varies among males, sometimes from the same locality.

#### *ANTHIDIUM CHUBUTI* COCKERELL, 1910

FEMALE, FIGS 60, 140; MALE, FIGS 219, 289, 344, 421, 497

*Anthidium chubuti* Cockerell, 1910: 214 (holotype: BMNH 17a.1876; ♀, Valle del Lago Blanco (‘Xanco’), Chubut, Argentina).

*Anthidium patagonicum* Schrottky, 1910: 269 (lectotype: MZUSP; ♀, Patagonia, Argentina); Urban, 2001a: 268 (lectotype designation).

*Anthidium chubuti patagonicum* Schrottky; Moure, 1957: 206 (change of status).

*Anthidium gutierrezii* Moure, 1957: 208 (holotype: DZUP; ♂, Penhue, Chile); Toro & Rodríguez, 1998: 69 (synonymy with *chubuti*).

*Diagnosis*: The female is easily separated from all other NW *Anthidium* by T6 with disc strongly protu-

berant basomedially, distal margin with deep median emargination, and lateral spine long, acute, surpassing, or nearly surpassing, the distal margin (Fig. 140). The male can be easily recognized by the following combination of characters: T7 with lateral lobe spiniform, about the same width and length as the lateral spine of T6 and median spine of T7 (Fig. 219); and S3 with distinct apical brush of black hairs as on S4 (Fig. 289).

*Description*: *Female*. Body length 12.0–13.0 mm; forewing length 8.7–10.0 mm. *Structure*. Clypeus prominently convex, projected about 0.4× width of compound eye in profile, distal margin thin, straight, not distinctly projecting sublaterally (Fig. 60); mandible with six or seven teeth; labrum without basal and preapical protuberances; F1 twice as long as broad, slightly shorter (0.9×) than combined lengths of F2 and F3; vertex, between lateral ocellus and compound eye, slightly depressed. Tibial carina absent. T6 strongly protuberant basomedially, concave preapically, narrowed apically in dorsal view, with long, acute lateral spine surpassing or nearly surpassing distal margin, median emargination deep, preapical carina absent (Fig. 140). *Coloration*. Black, except cream or yellow maculations as follows: broad band on vertex (sometimes reduced), T1 and often T2 with large irregular spot laterally, T3–T5 with small submedian spots, larger on T5; ferruginous on antenna (darker on apical segments), pronotal lobe (sometimes entirely black), tegula, apices of femora, tibiae, and tarsi. Wings light orange; veins ferruginous (including stigma and prestigma), slightly darker distally. *Pubescence*. Black, except yellowish to ferruginous hairs on vertex, pronotal lobe, tegula, scutum, axilla, scutellum, sides of metanotum, and ferruginous areas of legs. *Sculpturing*. Propodeal triangle shiny, finely imbricate. T1–T5 with weakly elevated discal areas, smooth and shiny between punctures (2–3× PW); depressed marginal zones more densely punctate than on discs (1–2× PW); distal margins smooth, about one-third to one-quarter width of depressed marginal zone.

*Male*. Body length 13 mm; forewing length 9.1 mm. *Structure*. F1 1.6× longer than broad, shorter (0.6×) than combined lengths of F2 and F3. Lateral spine of T6 gently curved, about as long as median spine of T7; lateral lobe of T7 spiniform, about the same width and length of lateral spine of T6 (Fig. 219); S3 with apical brush of black short hairs on elevated median third of straight distal margin; S4 with apical brush of black short hairs on median two-thirds of concave distal margin (Fig. 289); S6, in ventral view, with basal margin four-lobed, medially emarginate, distal margin gently convex, thick, medially notched (Fig. 344); S7 hemisternite apically pointed (Fig. 421);

S8 with short, narrow, curved, weakly bifid apical process, basally broad, about one-third width of distal margin (Fig. 497). Genitalia: gonostylus robust, 3.0× longer than broad, apically pointed in profile view; volsella long, nearly half of gonostylar length, apically hooked, dorsally directed, basally broad on dorsal margin; penis valve about as long as gonostylus, narrow, blade-like, dorsally projected next to medial projection, dorsoapical patch of hairs reduced or absent, medial projection large, distinct. *Coloration*. As in female, except yellow or cream on outer surface of mandible, inferior paraocular area, and clypeus; terga sometimes with larger spots than in female; T6 and T7 black. *Pubescence*. Sterna with brownish hairs. Face, fore femur, and mesepisternum with white hairs. *Sculpturing*. T1–T5 with depressed marginal zones slightly more densely punctate than in female.

*Distribution*: ARGENTINA: Chubut, Mendoza, Santa Cruz; CHILE: from Maule to Magallanes (200–2700 m a.s.l.). Found in the Magellanic subpolar forests, Patagonian and Southern Andean steppe, and Valdivian temperate forests ecoregions.

*Phenology*: December–early March.

*Comments*: Schwarz (1943: 3) mentioned that Cockerell (1910: 214) regarded *A. patagonicum* as a synonym of *A. chubuti*, but there is no mention of this statement in Cockerell's paper. Specimens from Lago Azul (Magallanes, Chile) and Las Máscaras (Patagonia, Argentina) have reduced maculations on the terga.

#### ANTHIDIUM CLYPEODENTATUM SWENK, 1914

FEMALE, FIGS 7, 61, 141; MALE, FIGS 43, 220, 290, 345, 422, 498; MAP, FIG. 577

*Anthidium clypeodentatum* Swenk, 1914: 12 (holotype: UNSM; ♀, Sioux Co., Nebraska, USA).

*Anthidium incurvatum* Swenk, 1914: 22 (holotype: UNSM; ♂, Ute Creek, Costilla Co., Colorado, USA); Grigarick & Stange, 1968: 15 (synonymy with *clypeodentatum*).

*Anthidium emarginatum* var. *bilineatum* Schwarz, 1927a: 4 (holotype: AMNH; ♂, Cascade, Colorado, USA); Grigarick & Stange, 1968: 15 (synonymy with *clypeodentatum*).

*Anthidium clypeodentatum* var. *lutzi* Schwarz, 1928: 380–383 (holotype: whereabouts unknown; ♀, 'W' (Mt. Wilson), California, USA; not examined); Grigarick & Stange, 1968: 15 (synonymy with *clypeodentatum*).

*Diagnosis*: This species can be distinguished from all other NW *Anthidium* except *A. psoraleae* by the antennal scape tomentose (as in Fig. 14), female T6 medially projected (Fig. 141), and male T7 with lateral lobe broad, with inner margin sharply angled (Fig. 220). The female can be easily separated from *A. psoraleae* by the clypeus with distal margin strongly tuberculate or toothed (Fig. 61) and T6 without distinct lateral spine or projection (Fig. 141). The male differs from *A. psoraleae* in the S6, with median lobe small, nearly triangular (Fig. 345), and S4 with distal margin less concave and with sparser hairs medially (compare Figs 290 and 322).

*Description*: *Female*. Body length 8.3–11.1 mm; forewing length 6.8–8.0 mm. *Structure*. Clypeus prominently convex, projected about 0.5× width of compound eye in profile, distal margin strongly tuberculate or toothed (Fig. 61); mandible with seven teeth of similar sizes (Fig. 7); labrum without basal protuberances, preapical projections large, distinctly curved upwards; F1 1.6× longer than broad, shorter (0.6×) than combined lengths of F2 and F3. Tibial carina absent. T6 slightly depressed above minutely crenulate preapical carina, basally elevated along midline, without distinct lateral angle or projection, distal margin narrowly projected medially (Fig. 141). *Coloration*. Black, except dark brown on antenna, legs, and sterna; yellow or cream maculations as follows: outer surface of mandible (usually absent), clypeus except along midline (usually absent), lower paraocular area (usually absent), longitudinal broad band laterally on vertex (sometimes connected to narrower transversal band), small spot on anterior surface of pronotum (usually absent), pronotal lobe (sometimes absent), anterior margin of tegula, continuous broad band on anterolateral and lateral margins of scutum (usually reduced or absent), axilla (sometimes reduced), distal half of scutellum, except medially, inferior margins of femora distally (usually absent), outer surfaces of tibiae and basitarsi (usually absent), and medially narrowed bands on terga (sometimes interrupted), laterally notched on anterior margin (T1 frequently notched on posterior margin, T6 usually black). Wings hyaline, slightly brownish; veins and stigma dark brown. *Pubescence*. Whitish or yellowish, darker on fore and mid basitarsi, inner surface of hind basitarsus and usually on S6. Scape with posterior surface densely covered by tomentum (as in Fig. 14). Outer surfaces of fore and middle basitarsi sparsely covered by tomentum (integument barely visible among hairs). *Sculpturing*. Propodeal triangle shiny, weakly lineolate. T1–T5 with strongly elevated discal areas, weakly shiny, weakly imbricate between punctures (1–2× PW); depressed marginal zones with punctures slightly closer than on discs;



basal three terga with distal margins usually broad (one-sixth width of depressed marginal zone), thicker, weakly doubly carinate, T4 and T5 with distal margins thin, very narrow ( $\leq 1\times$  PW) to nearly absent.

**Male.** Body length 8.5–13.8 mm; forewing length 6.9–8.6 mm. **Structure.** Labrum with low basal protuberances; F1 1.7 $\times$  longer than broad, shorter (0.7 $\times$ ) than combined lengths of F2 and F3. Lateral spine of T6 gently curved, about as long as median spine of T7; lateral lobe of T7 broad, about 1.5 $\times$  broader than distance between inner margin and median spine, with acute inner angle (Fig. 220); S4 with some thick, reddish brown hairs on weakly concave median third of distal margin, not forming distinct brush (Fig. 290); S6, in ventral view, with basal margin medially projected, with short, low, sublateral carina on disc, lateral lobe absent, median lobe small, triangular (Fig. 345); S7 hemisternite somewhat rounded distally (Fig. 422), with strong apodeme laterally, as seen in profile; S8 with distal margin slightly projected medially, truncate, weakly sclerotized along midline distally (Fig. 498). Genitalia: gonostylus robust, about 3.0 $\times$  longer than broad; volsella small, about one-third of gonostylar length, apically truncate, ventrally pointed, dorsally broadly rounded; penis valve about half of gonostylar length, broad, apex with laterally directed, curved projection and weakly sclerotized, medially directed point, dorsoapical patch of hairs present, medial projection small. **Coloration.** As in female, except: mesosoma with maculations often reduced; yellow maculations as follows: outer surface of mandible, clypeus except for distal margin (sometimes with two small basal dark spots), anterior surface of scape (sometimes reduced or absent), inferior paraocular area, basitarsi, and large spot laterally on T7 (usually reduced or absent). **Pubescence.** Vertex, scutum, and scutellum usually covered with yellowish or brownish hairs; basitarsi with whitish hairs. Posterior surface of scape not covered by dense tomentum as in female. **Sculpturing.** Terga smoother, shinier between punctures than in female.

**Distribution:** Western CANADA: Yukon, British Columbia, Alberta, Saskatchewan. USA: California and Arizona to Washington, Montana, North Dakota, South Dakota, Colorado. MEXICO: northern Baja California (70–3500 m a.s.l.). One of the most widely distributed Nearctic species, but infrequently collected; occurs in diverse ecoregions from chaparral, the margins of hot deserts, and upper elevations of shrub steppe to montane forests and grasslands (Fig. 577).

**Phenology:** April–August; majority of records (82%) from June through first half of August.

**Floral records:** Appears to favour Fabaceae (93% of records), especially *Lotus* and *Astragalus*. ASTERACEAE: *Grindelia* sp. FABACEAE: *Astragalus douglasii* var. *parishii*, *Astragalus tenellus*; *Lotus corniculatus*, *Lotus davidsonii*, *Lotus heermannii*, *Lotus nevadensis*, *Lotus nevadensis* var. *nevadensis*, *Lotus oblongifolius*, *Lotus scoparius*; *Lupinus* sp.; *Trifolium pratense*. ROSACEAE: *Rubus* sp.

**Comments:** There are two colour morphs in this species. In northern portions of its range, markings are cream coloured, in the female, absent from the face, mandible, and T6. In individuals from the White Mountains on the Nevada/California border, and in cismontane California, maculations are yellow, present on the face (usually including clypeus), T6, and usually the mandible of females. In addition, the impunctate apical margins of the terga are narrower in the yellow morph. The type of *A. clypeodentatum* var. *lutzi* is presumably lost.

#### ANTHIDIUM COCHIMI SNELLING, 1992

FEMALE, FIGS 62, 142; MALE, FIGS 221, 346, 423, 499; MAP, FIG. 576

*Anthidium cochimi* Snelling, 1992: 175–178 (holotype: LACM; ♂, Santa Rita, Baja California Sur, México).

**Diagnosis:** The female of this species is most similar to that of *A. maculifrons* in T1–T5, with discal areas strongly elevated, and in T6 with preapical carina minutely crenulate and lateral projection small and acute (Fig. 142). It differs from *A. maculifrons* by the clypeus weakly convex with distal margin non-tuberculate (Fig. 62) (except for the low sublateral tubercles) and the labrum without preapical projections. In *A. maculifrons*, the clypeus is prominently convex with the distal margin weakly tuberculate (Fig. 90) and the preapical labral projections are small but present. Also, the disc of the clypeus and distal half of the supraclypeal area are covered with normal hairs, whereas these areas are covered with apically hooked hairs in *A. cochimi*. The male of *A. cochimi* is easily separated from all North American *Anthidium* by the T7 with broadly triangular lobe (Fig. 221), and by the shape of S6 (Fig. 346) and S8 (Fig. 499).

**Description: Female.** Body length 9.5–13.2 mm; forewing length 5.8–7.4 mm. **Structure.** Clypeus weakly convex, projected about 0.3 $\times$  width of compound eye in profile, distal margin straight, non-tuberculate, except low sublateral tubercles (Fig. 62); mandible with seven or eight teeth; labrum with distinct basal protuberances separated by about width of

protuberance, preapical projections absent, barely indicated by elevated border on lateral margin of furrow; F1 1.6× longer than broad, shorter (0.7×) than combined lengths of F2 and F3. Tibial carina present. T6 convex in profile, lateral spine small, distinct, preapical carina minutely crenulate, depressed apical rim visible only on median one-fifth of distal margin (Fig. 142), not strongly projecting into ventral lobe as in *A. porterae*. *Coloration*. Dark brown to black, except yellow maculations as follows: outer surface of mandible, clypeus except distal margin and basal half along midline (usually on basal one-quarter), inferior paraocular area, anterior surface of scape (usually reduced or absent), broad band on vertex, pronotal lobe, anterior half of tegula, continuous broad band on anterolateral and lateral margins of scutum (sometimes reduced or broken), axilla (sometimes reduced), distal half of scutellum, except medially, broad band on outer surfaces of fore and middle tibiae ending well before apices, outer surface of hind tibia basally, outer surface of hind basitarsus (sometimes reduced to base), medially interrupted bands on T1–T5, deeply notched laterally on anterior margin (sometimes broken into four spots), and two large submedian spots on T6. Wings hyaline, slightly brownish; veins and stigma dark brown. *Pubescence*. Whitish, except yellowish to brownish hairs on vertex, scutum, axilla, scutellum, inner surfaces of tarsi, and S6. Clypeus and distal half of supraclypeal area sparsely covered with thin, apically curved hairs. Outer surfaces of basitarsi densely covered by tomentum (integument not visible among hairs). *Sculpturing*. Propodeal triangle dull, finely imbricate–lineolate. T1–T5 with strongly elevated discal areas, dull or weakly shiny, weakly imbricate between punctures (2–3× PW); depressed marginal zones with coarse punctures as on discs, denser ( $\leq 1.0\times$  PW); distal margins thick, doubly carinate, narrow (2–3× PW).

*Male*. Body length 15.0–17.7 mm; forewing length 8.5–8.9 mm. *Structure*. Labrum with basal protuberances slightly closer than in female, separated by less than width of protuberance; F1 1.4× longer than broad, shorter (0.6×) than combined lengths of F2 and F3. Lateral spine of T6 gently curved, longer than median spine of T7; lateral lobe of T7 broadly subtriangular, or nearly so (Fig. 221); S4 without apical brush, distal margin straight or nearly straight; S6, in ventral view, with gently convex basal margin, broadly rounded laterally, with distinct hook or curved spine on distal margin (Fig. 346); S7 hemisternite apically rounded (Fig. 423); S8 with short, broad apical process, about one-quarter width of distal margin basally, distinctly angled laterally (Fig. 499). Genitalia: gonostylus robust, 3.0× longer than broad, nearly parallel-sided, apically truncate, as seen in profile; volsella small, about one-third of

gonostylar length, triangular in ventral view, apically truncate in profile, ventrally pointed; penis valve about two-thirds of gonostylar length, apically pointed, dorsoapical patch of hairs absent, medial projection large, distinct. *Coloration*. As in female, except yellow on clypeus, basitarsi, and T7 (usually absent); maculations usually reduced on mesosoma. *Pubescence*. Vertex, scutum, and scutellum usually with pale hairs.

*Distribution*. USA: southern Arizona, southern New Mexico, Texas. MEXICO: Baja California Sur, Baja California, Sonora, Durango, Coahuila, Guanajuato (100–2900 m a.s.l.). Endemic to the Baja California, Sonoran and Chihuahuan deserts, Gulf of California, and San Lucan xeric scrub ecoregions; absent from the adjacent Mojave Desert (Fig. 576).

*Phenology*. March–June, late September–early November.

*Floral records*: ASTERACEAE: *Baileya multiradiata*; *Gaillardia* sp. FABACEAE: *Mimosa* sp.; *Prosopis* sp. ZYGOPHYLLACEAE: *Larrea tridentata*.

*Biology*: This species may nest in abandoned nests of *Diadasia* Patton, 1879 (Apidae), as indicated by a specimen label on a female collected in Pinal, Arizona, deposited in the AMNH.

#### ANTHIDIUM COCKERELLI SCHWARZ, 1928

FEMALE, FIGS 63, 143; MALE, FIGS 222, 291, 347, 424, 500; MAP, FIG. 577

*Anthidium cockerelli* Schwarz, 1928: 386 (holotype: AMNH; ♂, nr. Oasis, California, USA).

*Diagnosis*: The female can be recognized by the following combination of characters: tibial carina absent; basitarsi with outer surfaces densely covered with white tomentum (integument not visible among hairs); sternal scopa whitish, at least laterally; terga finely and sparsely punctate (as described below); T6 without distinct lateral spine, with depressed apical rim visible along three-quarters of obtusely angled distal margin (Fig. 143). The male can be recognized by: T7 with lateral lobe narrowly rounded at apex (Fig. 222); S6 without lateral lobe, with small, weakly sclerotized median lobe, sometimes apically notched (Fig. 347); S8 with pointed apical process (Fig. 500).

*Description: Female*. Body length 7.7–10.0 mm; forewing length 6.2–7.7 mm. *Structure*. Clypeus weakly to prominently convex, projected about 0.4× width of compound eye in profile, distal margin thin, nearly straight between sublateral tubercles (Fig. 63);

mandible with five or six teeth; labrum without basal protuberances, preapical projections large, distinctly curved upwards; F1 1.6× longer than broad, shorter (0.8×) than combined lengths of F2 and F3. Tibial carina absent. T6 gently elevated along midline, without distinct lateral spine, preapical carina minutely crenulate, depressed apical rim visible along three-quarters of distal margin, usually hidden by preapical carina and hairs, thus often visible only medially (Fig. 143). *Coloration*. Dark brown to black, except light brown to ferruginous on antennal flagellum, tegula, and tarsi; cream or yellow maculations as follows: outer surface of mandible, clypeus (usually absent or with two large yellow spots on distal half), inferior paraocular area (sometimes reduced), oval spot laterally on vertex (sometimes broadly interrupted band), pronotal lobe, anterior third of tegula (sometimes entire tegula, except on centre), anterolateral and lateral margins of scutum (usually absent), axilla (usually absent), distal half of scutellum except medially (usually reduced or absent), ventral surface of hind coxa distally (usually absent), superior and inferior margins of femora distally (usually absent), outer surfaces of tibiae basally (sometimes entire surface), T1–T5 with four large spots (sometimes with medially interrupted band, laterally deeply notched on anterior margin, except on T1), and T6 with two large submedian spots (sometimes entirely yellow, except two small lateral dark spots, base, and along midline). Wings hyaline, slightly brownish; veins ferruginous basally, dark brown distally, including stigma. *Pubescence*. Whitish, except sometimes yellowish hairs on vertex, scutum, axilla, scutellum; brownish hairs on inner surfaces of tarsi and sternal scopa, except laterally (sometimes entirely whitish). Outer surfaces of basitarsi densely covered by tomentum (integument not visible among hairs). *Sculpturing*. Propodeal triangle shiny, finely imbricate-lineolate. T1–T5 with weakly elevated discal areas, dull to weakly shiny, weakly imbricate between fine, sparse punctures (2–3× PW); depressed marginal zones with closer punctures than on discs, punctures nearly contiguous laterally, sparser (1–3× PW) medially; distal margins dull, narrow (2–3× PW), little or not differentiated from rest of depressed marginal zone.

*Male*. Body length 8.5–13.1 mm; forewing length 6.2–7.7 mm. *Structure*. Labrum with tuberculate preapical projections, smaller than in female; F1 1.4× longer than broad, shorter (0.5×) than combined lengths of F2 and F3. Lateral spine of T6 straight or nearly straight, as long as median spine of T7; lateral lobe of T7 narrowly rounded, 1.5× broader than distance between inner margin and median spine (Fig. 222); S4 with short, inconspicuous, pale or light reddish brown apical brush on median one-fifth of

straight distal margin, hidden by long, branched pale hairs (Fig. 291); S6, in ventral view, with gently convex basal margin, obliquely truncate laterally, without distinct lateral lobe, median lobe small, weakly sclerotized, sometimes apically notched (Fig. 347); S7 hemisternite apically rounded (Fig. 424); S8 with triangular apical process on median half of distal margin (Fig. 500). Genitalia: gonostylus robust, slightly more than 3.0× longer than broad; volsella very small, about one-sixth of gonostylar length, triangular in ventral view, obliquely truncate in profile; penis valve about three-quarters of gonostylar length, apically pointed, curved, dorsoapical patch of hairs absent, medial projection small. *Coloration*. As in female, except yellow maculations on anterior surface of scape (usually absent or reduced), clypeus, inferior paraocular area, basitarsi, and T7. *Pubescence*. Vertex, scutum, and scutellum usually with pale hairs. *Sculpturing*. Propodeal triangle sometimes smooth, shiny. T1–T5 with broader distal margins than in female (4–6× PW).

*Distribution*: USA: southern California, southern Nevada, southern Utah, Arizona, southern New Mexico, western Texas. MEXICO: Baja California, Durango, Coahuila (from –80 to 2200 m a.s.l.; records from below sea level are from Death Valley, California). Restricted to the hot deserts (Mojave, Sonoran, and Chihuahuan deserts), Colorado Plateau, and Great Basin (Fig. 577).

*Phenology*: February–June; majority of records (90%) from April through June 15.

*Floral records*: ASCLEPIADACEAE: *Astephanus utahensis*. ASTERACEAE: *Ambrosia dumosa*; *Artemisia* sp.; *Baileya multiradiata*, *Baileya multiradiata* var. *pleniradiata*; *Bebbia juncea*; *Chaenactis carphoclinia*, *Chaenactis fremontii*, *Chaenactis stevioides*; *Cirsium* sp.; *Coreopsis* sp.; *Encelia farinosa*, *Encelia virginensis*; *Enceliopsis* sp.; *Geraea canescens*; *Malacothrix* sp.; *Palafoxia linearis*; *Pluchea sericea*; *Stephanomeria tenuifolia*. BORAGINACEAE: *Phacelia crenulata*, *Phacelia distans*, *Phacelia integrifolia*, *Phacelia pachyphylla*, *Phacelia rafaelensis*. BRASSICACEAE: *Stanleya pinnata*. CACTACEAE: *Opuntia* sp. FABACEAE: *Astragalus* sp.; *Cercidium microphyllum*; *Dalea arborescens*, *Dalea californica*, *Dalea formosa*, *Dalea parryi*, *Dalea schottii*; *Hoffmannseggia microphylla*; *Lotus haydonii*, *Lotus scoparius*; *Lupinus agardhianus*, *Lupinus argenteus* var. *argentatus*, *Lupinus sparsiflorus*; *Melilotus* sp.; *Prosopis juliflora*; *Psoralea* sp.; *Psorothamnus arborescens*, *Psorothamnus emoryi*, *Psorothamnus fremontii*, *Psorothamnus polydenius*, *Psorothamnus spinosus*, *Psorothamnus thompsoniae*. GROSSULARIACEAE: *Ribes aureum*.



KRAMERIACEAE: *Krameria* sp. LAMIACEAE: *Polioanthus incana*; *Salazaria mexicana*; *Salvia dorrii*. LOASACEAE: *Mentzelia involucrata*, *Mentzelia tricuspidis*. MALVACEAE: *Sphaeralcea* sp. NYCTAGINACEAE: *Abronia villosa*. ONAGRACEAE: *Oenothera clavaeformis* var. *aurantiaca*. PAPAVERACEAE: *Arctomecon californica*. PLANTAGINACEAE: *Penstemon palmeri*. POLYGONACEAE: *Eriogonum fasciculatum*, *Eriogonum inflatum*. RANUNCULACEAE: *Delphinium* sp. TAMARICACEAE: *Tamarix* sp. ZYGOPHYLLACEAE: *Larrea tridentata*.

**Biology:** In the low deserts this species flies from late March to early May (Hurd & Linsley, 1975), where it frequents creosote bush, and from May to early June in the Colorado Plateau.

**Comments:** A single male, ostensibly from Mount Hamilton, Santa Clara County, California (UCDC) seems questionable. There are no other non-desert records from California, including no specimens found during a multi-year study at nearby Pinnacles National Monument. The record is not represented on the map (Fig. 577).

#### ANTHIDIUM COLLECTUM HUARD, 1896

FEMALE, FIGS 24, 64, 144; MALE, FIGS 223, 292, 348, 425, 501; MAP, FIG. 578

*Anthidium compactum* Provancher, 1896: 9 (lectotype: MPQ; ♂, Los Angeles, California, USA; not examined) (Preoccupied name).

*Anthidium collectum* Huard, 1896: 124 (new name for *A. compactum* Provancher).

*Anthidium angelarum* Titus, 1906: 164 (holotype: USNM 9034; ♀, Los Angeles County, California, USA); Schwarz, 1927c: 1 (synonymy with *collectum*).

*Anthidium transversum* Swenk, 1914: 19 (holotype: UNSM; ♀, Pacific Grove, California, USA); Grigarick & Stange, 1968: 17 (synonymy with *collectum*).

*Anthidium puncticaudum* Cockerell, 1925a: 360 (holotype: CAS 1742; ♂, Colton, California, USA); Timberlake in Michener, 1951: 1140 (synonymy with *collectum*).

*Anthidium collectum bilderbacki* Cockerell, 1938: 38 (holotype: SDNHM; ♀, Santa Barbara Island, California, USA); Grigarick & Stange, 1968: 17 (synonymy with *collectum*).

*Anthidium catalinense* Cockerell, 1939a: 433 (holotype: UCR; ♂, Fisherman's Cove, Santa Catalina Island, California, USA); Grigarick & Stange, 1968: 17 (synonymy with *collectum*).

*Anthidium clementinum* Cockerell, 1939b: 138 (lectotype: UCR; ♂, San Clemente Island, California, USA); Grigarick & Stange, 1968: 17 (synonymy with *collectum*) (**new lectotype designation**).

**Diagnosis:** The female of this species is similar to that of *A. labergei* sp. nov. in the absence of a tibial carina, basitarsi with outer surfaces densely covered by tomentum, sternal scopa whitish, and terga dull to weakly shiny, densely punctate (Fig. 24). In addition to the extensive yellow maculations on the outer surface of the mandible, inferior paraocular area, and clypeus, it can be separated from *A. labergei* sp. nov. by the clypeus more convex, with distal margin wavy, not strongly projected sublaterally (Fig. 64), T6 with depressed apical rim visible along median three-quarters of distal margin (Fig. 144), and terga duller, more coarsely punctate. In *A. labergei* sp. nov. the outer surface of the mandible, inferior paraocular area, and clypeus are largely black, sometimes with diffused yellow spots; the clypeus is also less produced in profile, and the distal margin is not usually wavy and more strongly projected sublaterally, thus appearing gently concave (Fig. 86); the depressed apical rim of T6 is less projected than in *A. collectum*, only visible on median one-half of distal margin (Fig. 166). The male resembles that of *A. schwarzi* sp. nov. by T7 with lateral lobe narrowly rounded, S4 with distinct apical brush of black hairs, and S6 obliquely truncate laterally, with median lobe small, apically notched. However, in *A. collectum* the lateral lobe of T7 is narrower, at most as wide as the distance between its inner margin and the median spine (Fig. 223); and S4 is less concave on distal margin, with shorter hairs on the apical brush (Fig. 292). It also differs in the shapes of S6–S8.

**Description: Female.** Body length 8.5–9.7 mm; forewing length 6.2–6.9 mm. **Structure.** Clypeus prominently convex, projected about 0.5× width of compound eye in profile, distal margin thin, wavy, two lateralmost tubercles usually more distinctly projected (Fig. 64); mandible with five or six teeth; labrum with basal protuberances barely indicated by median longitudinal depression, preapical projections large, distinctly curved upwards; F1 1.6× longer than broad, shorter (0.8×) than combined lengths of F2 and F3. Tibial carina absent. T6 straight or nearly straight in profile, gently elevated along midline, without distinct lateral angle, preapical carina absent, depressed apical rim visible along median three-quarters of truncate distal margin (Fig. 144). **Coloration.** Dark brown to black, except light brown to ferruginous on tarsi; yellow maculations as follows: outer surface of mandible, clypeus except distal margin and two small basal spots, inferior paraocular area, oval spot or short band laterally on vertex, pronotal lobe, margins of tegula, anterolateral and lateral margins of scutum (usually reduced, rarely forming continuous band), axilla (usually reduced or absent), distal half of scutellum except medially

(usually reduced), inferior margins of femora distally (usually reduced or absent), outer surfaces of tibiae (usually reduced to longitudinal band), T1 with four spots (sometimes medially interrupted band, laterally deeply notched on posterior margin), T2–T5 with bands narrowed medially (usually medially interrupted on T2 and T3), laterally deeply notched on anterior margin, and T6 entirely (sometimes with two large submedian spots). Wings hyaline, slightly brownish; veins and stigma dark brown. *Pubescence*. Whitish, except yellowish to brownish hairs on vertex, scutum, axilla, scutellum, inner surface of tarsi, terga (except sides of T1), and S6. Outer surfaces of basitarsi densely covered by tomentum (integument not visible among hairs). *Sculpturing*. Propodeal triangle weakly lineolate, usually smooth and shiny. T1–T5 with weakly elevated discal areas, dull or weakly shiny, weakly imbricate between fine, dense punctures (1–2× PW); depressed marginal zones with punctures nearly contiguous; distal margins narrow (1–2× PW), broadest on T1 (Fig. 24).

*Male*. Body length 10.0–13.8 mm; forewing length 6.2–9.2 mm. *Structure*. Labrum with preapical projections larger than in female; F1 1.4× longer than broad, shorter (0.6×) than combined lengths of F2 and F3. Lateral spine of T6 straight or nearly straight, about as long as median spine of T7; lateral lobe of T7 elongate, narrowly rounded, about as wide as or slightly narrower than distance between inner margin and median spine (Fig. 223); S4 with broad (about one-third sternal width), dense apical brush of black, short hairs on gently concave distal margin (Fig. 292); S6 with gently convex basal margin, lateral lobe small, acute, median lobe apically notched (Fig. 348); S7 hemisternite apically truncate (Fig. 425); S8 with apical process tapering in ventral view, apex ventrally bent (~100°) in profile view (Fig. 501). Genitalia: gonostylus robust, 3.0× longer than broad; volsella small, about one-third of gonostylar length, somewhat triangular in ventral view, truncate in profile; penis valve about half of gonostylar length, apex broad, flattened, ending in small point, dorsoapical patch of hairs present, medial projection small. *Coloration*. As in female, except yellow on clypeus and basitarsi; T2 and T3 with bands usually broken into four spots; T7 usually without yellow. *Pubescence*. Vertex, scutum, axilla, scutellum, and terga usually with pale hairs. *Sculpturing*. Terga shinier, with finer punctures than in female.

*Distribution*. USA: cismontane California and adjacent southern Oregon; isolated record from south central Washington (0–2100 m a.s.l.). Found principally at lower elevations (85% of records < 1000 m a.s.l.) in grassland, chaparral, woodland,

and rarely coastal forest ecoregions (Fig. 578). Anomalous record from Blythe, California.

*Phenology*: March–early August, early October; with majority of records (88%) from April through June.

*Floral records*: Majority of visits to *Lotus* (53%) and *Phacelia* (31%). ADOXACEAE: *Sambucus* sp. ASTERACEAE: *Chaenactis glabriuscula*; *Encelia farinosa*. BORAGINACEAE: *Amsinckia intermedia*; *Cryptantha intermedia*; *Eriodictyon californicum*, *Nemophila* sp.; *Phacelia cicutaria* var. *cicutaria*, *Phacelia cicutaria* var. *hispida*, *Phacelia distans*, *Phacelia heterophylla*, *Phacelia imbricata*, *Phacelia malvifolia*, *Phacelia ramosissima*, *Phacelia tanacetifolia*. FABACEAE: *Astragalus* sp.; *Lotus argophyllus*, *Lotus argophyllus ornithopus*, *Lotus corniculatus*, *Lotus hermannii*, *Lotus humistratus*, *Lotus procumbens*, *Lotus scoparius*; *Lupinus albifrons*; *Trifolium* sp., *Vicia villosa*. LAMIACEAE: *Marrubium* sp., *Trichostema lanatum*. ONAGRACEAE: *Oenothera* sp. PHRYMACEAE: *Mimulus fremontii*. POLEMONIACEAE: *Eriastrum pluriflorum*. SALICACEAE: *Salix* sp. SOLANACEAE: *Solanum* sp. VIOLACEAE: *Viola* sp.

*Biology*: Nests consist of between one and four cells built inside hollow stems or in the ground, including abandoned nests of other bees, which are plugged with packs of trichomes and pebbles (Hicks, 1929c; Ferguson, 1962). According to Hicks (1929c), cells are made with trichomes of *Artemisia tridentata* (Asteraceae).

*Comments*: Cockerell (1939b: 138) included *A. clementinum* in a paper listing the bee species found in the Channel Islands. He mentioned that his description was based on a male specimen, and was going to be published in a forthcoming paper. He also provided comparative comments on the male and a more detailed description of the female in the same paper. Although Grigarick & Stange (1968: 17) and Hurd (1979: 1987) indicated a female as the holotype, Cockerell never published a complete description nor designated a holotype for this species. Thus, to stabilize the name we designate a male specimen that bears a Cockerell-type label as the lectotype. The label data for this specimen are as follows: 'holotype (red label) // San Clemente I. May 39, (Cockerell) // illegible hand-writing // *Anthidium clementinum* Ckll. Type. // Lectotype *Anthidium clementinum* ♂ Cockerell, Des. V.H. Gonzalez & T. Griswold 2010'.

Some female specimens from the Channel Islands of California (USA) are slightly larger, with shinier terga and more strongly wavy clypeal margins than

specimens from other localities in California. The type of *A. compactum* could not be examined.

*ANTHIDIUM COLLIGUAYANUM* TORO & ROJAS, 1970

FEMALE, FIGS 65, 145; MALE, FIGS 224, 293, 349, 426, 502; MAP, FIG. 583

*Anthidium colliguayanum* Toro & Rojas, 1970: 147 (holotype: AMNH; ♂, Colliguay, Valparaíso, Chile).

**Diagnosis:** This species is similar to *A. chilense* and *A. gayi* in the small body size (8–11 mm in length) and coloration (i.e. antenna, tegula, legs, and base of wings ferruginous, and T1–T4 with broadly interrupted yellow or cream bands). In the female of *A. colliguayanum* the fore and mid basitarsi are densely covered by white tomentum on the outer surfaces, as in *A. chilense*, but such tomentum is absent on the hind basitarsus. It also differs from *A. chilense* by the clypeus black, weakly convex, covered with normal hairs, with distal margin distinctly thick and tuberculate, as in *A. gayi* (Fig. 65), and T6 with lateral spine small (Fig. 145). In *A. chilense*, the clypeus is yellow, prominently convex, sparsely covered with hooked or curved hairs, and has a thinner distal margin (Fig. 59), whereas T6 is laterally rounded, without a distinct lateral spine or angle (Fig. 139). The presence of white, dense tomentum on the fore and mid basitarsi and the sinuous depressed apical rim of T6 distinguish *A. colliguayanum* from *A. gayi*; the white tomentum is absent from all basitarsi and the depressed apical rim of T6 is broad and rounded in *A. gayi* (compare Figs 145 and 160). The male can be separated from *A. chilense* and *A. gayi* by T7 with lateral lobe broad, rounded (Fig. 224), and S6 with distal margin medially projected into a small, triangular lobe or point (Fig. 349). In *A. chilense* and *A. gayi* the lateral lobe of T7 is spiniform (Fig. 218) or subtriangular (Fig. 239), and the distal margin of S6 is broadly convex (Fig. 343) or nearly straight (Fig. 364), not projected into a small point or triangular lobe.

**Description:** *Female.* Body length 9.2–10.7 mm; forewing length 6.6–6.9 mm. **Structure.** Clypeus weakly convex, projected about 0.4× width of compound eye in profile, distal margin distinctly thick, tuberculate (Fig. 65); labrum without basal protuberances, preapical projections large, distinctly curved upwards; F1 1.7× longer than broad, slightly shorter (0.9×) than combined lengths of F2 and F3. Tibial carina absent. T6 gently convex basally, lateral spine small, acute, preapical carina minutely crenulate, depressed apical rim sinuous, not dorsally bent, projecting on median one-quarter of distal margin (Fig. 145). **Coloration.** Black, except cream or yellow

maculations as follows: outer surface of mandible (sometimes absent), rounded to oval spot laterally on vertex, T1–T4 with medially interrupted bands, laterally slightly notched on posterior margin, T5 with nearly complete band, medially notched on anterior margin; ferruginous on antenna (darker apically), pronotal lobe, tegula, and legs, except coxae and trochanters. Wings light orange basally, brownish distally; veins ferruginous basally (including stigma and prestigma), dark brown distally. **Pubescence.** Whitish, except yellowish to brownish hairs on vertex, scutum, axilla, scutellum, inner surfaces of tarsi, and S6; dark-brown to black hairs on depressed marginal zones of T1–T5 and T6 entirely. Outer surfaces of fore and middle basitarsi densely covered by tomentum (integument not visible among hairs). **Sculpturing.** Propodeal triangle weakly shiny, finely imbricate. T1–T5 with weakly elevated discal areas, shiny, weakly lineolate or imbricate between punctures (3–4× PW); depressed marginal zones more densely punctate than on discs (2–3× PW); distal margins broad, about one-quarter width of depressed marginal zone, little differentiated from it, narrowest on T5 (1–2× PW).

**Male.** Body length 10.0–11.0 mm; forewing length 7.5–7.7 mm. **Structure.** Labrum slightly tuberculate basally, preapical projections absent; F1 1.5× longer than broad, shorter (0.7×) than combined lengths of F2 and F3. Lateral spine of T6 gently curved, nearly straight, about as long as median spine of T7; lateral lobe of T7 broadly rounded, about 1.5× broader than distance between inner margin and median spine (Fig. 224); S4 with apical brush of short, reddish brown hairs on about one-quarter of medially projected distal margin (Fig. 293); S6, in ventral view, with basal margin gently convex to nearly straight, lateral spine small, sharp, laterally directed, distal margin gently convex, with small but distinct median point (Fig. 349); S7 hemisternite apically truncate (Fig. 426); S8 with narrow, short apical process, basally broad, about one-quarter width of distal margin (Fig. 502). **Genitalia:** gonostylus robust, 2.3× longer than broad; volsella large, about half of gonostylar length, apex dorsally and ventrally pointed; penis valve about as long as gonostylus, apex pointed, curved, blade-like, dorsoapical patch of hairs absent, medial projection large, distinct. **Coloration.** As in female, except yellow on outer surface of mandible, clypeus, inferior paraocular area, and basitarsi; T6 sometimes maculated. **Sculpturing.** Terga slightly shinier than in female.

**Distribution:** CHILE: Atacama to Maule (700–1400 m a.s.l.). Found in the Chilean matorral, Southern Andean steppe, and Valdivian temperate forests ecoregions (Fig. 583).



*Phenology*: September–February; majority of records (63%) in the limited sample in October.

*ANTHIDIUM CUZCOENSE* SCHROTTKY, 1910

FEMALE, FIGS 66, 146; MALE, FIGS 225, 294, 350, 427, 503

*Anthidium cuzcoense* Schrottky, 1910: 268 (lectotype: MZUSP; ♀, Cuzco, Peru); Urban 2001a: 265 (type designation).

*Diagnosis*: The female of this species is most similar to *A. masunariae* in the fore and mid basitarsi, with outer surfaces densely covered by tomentum and terga weakly shiny with broad distal margins. It can be separated from *A. masunariae* by the shape of T6 (medially projected in *A. cuzcoense* and truncate in *A. masunariae*) and the sternal scopa whitish; additionally, *A. cuzcoense* has T2–T5 with four yellow spots and T6 with two submedian spots, whereas *A. masunariae* has T1–T5 with medially interrupted bands and T6 without bands or spots. The male of *A. cuzcoense* can be recognized easily by the following combination of characters: terga weakly shiny with broad distal margins; T7 with lateral lobe narrow, elongate, apically rounded (Fig. 225); and S6 with distal margin straight or nearly straight, with discal lateral carina distinct, anteriorly curved in profile (Fig. 350).

*Description: Female*. Body length 10.0 mm; forewing length 7.7 mm. *Structure*. Clypeus weakly convex, projected about 0.4× width of compound eye in profile, distal margin thin, two lateralmost tubercles usually more distinctly projected (Fig. 66); labrum without basal protuberances, preapical projections large, distinctly curved upwards; mandible with six or seven teeth; F1 about twice as long as broad, slightly shorter (0.9×) than combined lengths of F2 and F3. Tibial carina present, sometimes weak. T6 straight in profile, lateral spine small, acute, preapical carina absent, depressed apical rim projecting on one-third of distal margin, median emargination barely indicated (Fig. 146). *Coloration*. Black, except antenna and legs (excluding distitarsi) dark brown; tegula and distitarsi ferruginous; cream or yellow maculations as follows: outer surface of mandible, distal two-thirds of clypeus, except medially (sometimes reduced to two apicolateral spots), rounded to oval spot laterally on vertex, small spot on apices of femora, outer surface of middle tibia, along posterior margin of hind tibia and basitarsus with broad band ending before apex, except in the latter, T1 with medially interrupted band, laterally deeply notched on posterior margin, T2–T5 with four large spots, and T6 with two large spots. Wings hyaline, slightly brownish; veins and

stigma dark brown. *Pubescence*. Whitish, except for light-brown to ferruginous hairs on inner surfaces of tarsi and S6; dark-brown to black hairs on vertex, scutum, axilla, scutellum, depressed marginal zone of T1–T4, and entire surface of remaining terga. Outer surfaces of fore and middle basitarsi densely covered by tomentum (integument not visible among hairs). *Sculpturing*. Propodeal triangle weakly shiny, finely imbricate. T1–T5 with weakly elevated areas, weakly shiny, weakly lineolate or imbricate between punctures (3–4× PW); depressed marginal zones slightly more densely punctate than on discs (1–2× PW); distal margins broad, about as wide as depressed marginal zone, broadest medially, little differentiated from it.

*Male*. Body length 12.3–13.8 mm; forewing length 8.5–10.0 mm. *Structure*. Labrum without preapical projections; F1 about as long as broad, shorter (0.7×) than combined lengths of F2 and F3. Lateral spine of T6 gently curved, nearly straight, about as long as median spine of T7; lateral lobe of T7 elongate, apically rounded, at most as wide as distance between inner margin and median spine, slightly diverging apically (Fig. 225); S4 with apical brush of long, reddish brown hairs on one-sixth of straight distal margin (Fig. 294); S6, in ventral view, with basal margin gently convex, distal margin straight or nearly straight, with distinct discal lateral carina, anteriorly curved in profile (Fig. 350); S7 hemisternite apically truncate (Fig. 427); S8 with narrow, short, gently curved apical process, basally broad, about one-quarter width of distal margin (Fig. 503). Genitalia: gonostylus robust, 2.5× longer than broad; volsella small, about one-third of gonostylar length, apex ventrally pointed; penis valve about as long as gonostylus, apex blade-like, not pointed, medially projecting into lobe, dorsoapical patch of hairs absent, medial projection large, distinct. *Coloration*. As in female except yellow on clypeus and basitarsi; maculations on tibiae usually reduced; T6 with medially interrupted band (sometimes broken into four spots or reduced to two submedian spots). *Sculpturing*. T1–T5 with distal margins distinctly broad, much wider than depressed marginal zone, especially medially.

*Distribution*: PERU: Cusco, Apurímac, Ayacucho, Ica (2400–3400 m a.s.l.). Present in Peruvian Yungas ecoregion.

*Phenology*: February–May.

*Comments*: A female in the FSCA collection (Peru, Cusco, Huato, 3100 m a.s.l., 1 May 1965, A.E. Florez) may be *A. cuzcoense*. It differs in the clypeus, which

has a more pronounced clypeal margin and is more convex in lateral view, and the scopa light brown medially.

*ANTHIDIUM DAMMERSI* COCKERELL, 1937

FEMALE, FIGS 67, 147; MALE, FIGS 226, 295, 351, 428, 504; MAP, FIG. 578

*Anthidium dammersi* Cockerell, 1937a: 6 (holotype: AMNH; ♂, Adelanto, 9 mi. N, Mojave Desert, California, USA).

**Diagnosis:** The female is easily recognized by the following combination of characters: clypeus prominently convex (Fig. 67); sternal scopa white; terga dull or weakly shiny, with depressed marginal zone finely and sparsely punctate medially (1–3× PW); and T6 distinctly convex in profile, with depressed apical rim completely visible across truncate distal margin (Fig. 147). Most males are similar to *A. atrifrons* in the broad submedian emargination of T7 (Fig. 226) and the apical brush of S4 with short hairs (Fig. 295); however, in *A. dammersi* the lateral lobe of T7 is usually dull, broader basally, and somewhat tapering distally; the lateral lobe of S6 (Fig. 351) is not as acute as in *A. atrifrons* (Fig. 336), and S7 hemisternite is distinctly pointed on the distal margin (Fig. 428). Occasional males have a narrow emargination on T7, as in *A. emarginatum*.

**Description: Female.** Body length 7.5–8.6 mm; forewing length 5.9–6.5 mm. **Structure.** Clypeus prominently convex, projected about 0.5× width of compound eye in profile, distal margin thin, wavy, two lateralmost tubercles usually distinctly projected (Fig. 67); mandible with five or six teeth; labrum without basal protuberances, preapical projections large, distinctly curved upwards; F1 1.8× longer than broad, slightly shorter (~0.8×) than combined lengths of F2 and F3. Tibial carina absent. T6 distinctly convex in profile, without distinct lateral spine, preapical carina absent, depressed apical rim completely visible across truncate distal margin (Fig. 147). **Coloration.** Black, except dark brown on antenna, mandible, sterna, and legs, excluding light brown to ferruginous tarsi; yellow or cream maculations as follows: rounded to oval spot laterally on vertex, pronotal lobe (sometimes reduced), tegula, except on disc, distal margin of scutellum, except medially (usually reduced), outer surfaces of tibiae (sometimes reduced to base), outer surface of hind basitarsus (usually absent), and medially interrupted bands on T1–T5, laterally usually deeply notched on anterior margin (T1 sometimes deeply notched on posterior margin laterally or with four spots). Wings hyaline, slightly brownish; veins and stigma dark

brown. **Pubescence.** Whitish, except light ferruginous hairs on inner surface of tarsi. Outer surfaces of fore and mid basitarsi densely covered by tomentum, integument not visible among hairs, at least basally, not appearing robust, with short, semierect, simple hairs as in *A. atrifrons*. **Sculpturing.** Propodeal triangle weakly lineolate, usually smooth and shiny. T1–T5 with weakly elevated discal areas, sparsely punctate (2–4× PW), usually finely imbricate–lineolate, dull or weakly shiny; depressed marginal zones with punctures slightly closer than on discs; distal margins dull (4–5× PW), little or not differentiated from rest of depressed marginal zone.

**Male.** Body length 8.5–10.2 mm; forewing length 6.3–7.8 mm. **Structure.** F1 1.3× longer than broad, shorter (0.6×) than combined lengths of F2 and F3; preapical labral projections longer than in female. Lateral spine of T6 straight or nearly straight, shorter than median spine of T7; lateral lobe of T7 tapering distally, basally broader (~1.5×) than distance between inner margin and median spine, inner margin gently sloping from submedian emargination, outer margin nearly straight (Fig. 226); S4 with broad (about one-third sternal width), dense, black brush of short hairs on nearly straight distal margin (Fig. 295); S6, in ventral view, with gently convex to nearly straight basal margin, outer margin of acute lateral lobe straight or nearly straight, median lobe nearly parallel-sided, apically truncate (Fig. 351); S7 hemisternite with pointed distal margin (Fig. 428); S8 with broad apical process, basally about half width of distal margin, deeply bifid apically, with pointed lobes ventrally bent (~100°) in profile view (Fig. 504). Genitalia: gonostylus somewhat robust, 4.3× longer than broad; volsella small, about one-third of gonostylar length, obliquely truncate, appearing triangular in ventral view; penis valve about half of gonostylar length, apex broad, flattened, ending in small curved point, dorsoapical patch of hairs present, medial projection small. **Coloration.** As in female except ivory or yellow maculations as follows: outer surface of mandible, clypeus, except apical margin, inferior paraocular area, and outer surfaces of basitarsi; scutellum with reduced maculations; T1–T5 with bands often more deeply notched laterally than in female; T6 usually with two submedian spots; T7 sometimes with two large spots. **Pubescence.** Inner surfaces of tarsi predominantly whitish.

**Distribution:** USA: southern California, Arizona to south-western New Mexico, Nevada, Utah, south-western Wyoming. MEXICO: Baja California (100–2300 m a.s.l.). Found in xeric regions, including Red Desert, Great Basin, Colorado Plateau, and Mojave Desert; largely absent from the Sonoran and Chihuahuan deserts (Fig. 578).

*Phenology*: April–June; most records (94%) from last half of April through first half of June.

*Floral records*: Majority of floral visits to *Astragalus* (60%). ASTERACEAE: *Baileya* sp., *Chaenactis stevioides*. BORAGINACEAE: *Amsinckia* sp., *Phacelia distans*. FABACEAE: *Astragalus bolanderi*, *Astragalus calcosus*, *Astragalus lentiginosus*, *Astragalus lentiginosus* var. *fremontii*, *Astragalus lentiginosus* var. *micans*, *Astragalus porrectus*, *Dalea* sp., *Hedysarum* sp., *Lathyrus brachycalyx zionis*, *Lupinus* sp., *Psoralea lanceolata*, *Psoralea fremontii*. LAMIACEAE: *Poliomintha incana*, *Salvia dorrii*. LOASACEAE: *Mentzelia* sp. OROBANCHACEAE: *Cordylanthus wrightii*.

#### ANTHIDIUM DANIELI URBAN, 2001

FEMALE, FIGS 68, 148; MALE, FIGS 227, 352, 429, 505; MAP, FIG. 583

*Anthidium danieli* Urban, 2001b: 540 [holotype: DZUP; ♂, San Jorge, Patagonia (Chubut), Argentina].

*Diagnosis*: This species superficially resembles *A. friesei* in the following combination of characters: large body size (> 11 mm in body length); body with abundant yellow markings; legs largely ferruginous; male T7 with lateral lobe narrow (Fig. 227); female clypeus with distal margin thick (Fig. 68); and overall shape of T6 (Fig. 148). The female can be easily separated from *A. friesei* by the six- or seven-toothed mandible; clypeus distinctly convex; basitarsi with outer surfaces not covered by tomentum; sternal scopa dark brown to black; and terga weakly shiny. The male can be separated from *A. friesei* by the terga dull, with narrower distal margins (about half width of depressed marginal zone); basitarsi ferruginous; and S6 with distal margin gently projected medially, not forming a distinct median lobe (Fig. 352). In addition, the tibial carina is absent in both sexes of *A. danieli* but often present in *A. friesei*.

*Description: Female*. Body length 11.5 mm; forewing length 7.7 mm. *Structure*. Clypeus prominently convex, projected about 0.5× width of compound eye in profile, distal margin distinctly thick, not distinctly projected sublaterally (Fig. 68); mandible with six or seven teeth; labrum without basal protuberances, preapical projections large, distinctly curved upwards; F1 about twice as long as broad, slightly shorter (0.9×) than combined lengths of F2 and F3. Tibial carina absent. T6 gently convex basally, lateral spine small, acute, preapical carina minutely crenulate, depressed apical rim short, projecting across slightly less than one-third of distal margin, median

emargination small (Fig. 148). *Coloration*. Black, except ferruginous on mandible (usually darkened), antenna (apical segments slightly darker), tegula, and legs (excluding coxae, trochanters, and base of femora); cream or yellow maculations as follows: distal two-thirds of clypeus, except medially (sometimes reduced to two large apicolateral spots), rounded to oval spot laterally on vertex, axilla, distal margin of scutellum, except medially, and T1–T5 with medially interrupted bands, laterally weakly notched on posterior margin. Wings light orange basally, brownish distally; veins ferruginous basally (including stigma and prestigma), dark brown distally. *Pubescence*. Whitish or yellowish, except dark brown to black on depressed marginal zones of T1–T4, entirely on remaining terga and sternal scopa. *Sculpturing*. Propodeal triangle weakly shiny, finely imbricate. T1–T5 with weakly elevated discal areas, weakly shiny, weakly lineolate–nearly smooth, shiny between punctures (2–4× PW); depressed marginal zones slightly more densely punctate than on discs (1–2× PW); distal margins about one-third to one-half width of depressed marginal zone, differentiated from it, broadest medially, narrowest on T5 (1–2× PW).

*Male*. Body length 13.8 mm; forewing length 8.9 mm. *Structure*. Labrum with preapical projections absent, barely indicated by elevated border on lateral margin of furrow; F1 1.8× longer than broad, shorter (0.7×) than combined lengths of F2 and F3. Lateral spine of T6 gently curved, nearly straight, about as long as median spine of T7; lateral lobe of T7 narrow, about as wide as distance between inner margin and median spine, apex obliquely truncate, thus apically diverging from midline (Fig. 227); S4 without distinct apical brush, at most with some dense, thick hairs on median one-quarter of straight distal margin; S6, in ventral view, with basal margin gently convex to nearly straight, lateral spine short, anterolaterally directed, distal margin medially projected, somewhat apically truncate (Fig. 352); S7 hemisternite apically truncate (Fig. 429); S8 with narrow, short, weakly bifid, curved apical process, basally about one-third of distal margin (Fig. 505). Genitalia: gonostylus robust, 3.0× longer than broad; volsella small, less than one-third of gonostylus length, somewhat apically truncate in profile; penis valve slightly shorter than gonostylus, apex blade-like, pointed, medially projecting into narrow lobe, dorsoapical patch of hairs absent, medial projection large, distinct. *Coloration*. As in female, except yellow on outer surface of mandible, clypeus, pronotal lobe, and anterior half of tegula (usually absent or reduced); anterior surface of scape and outer surfaces of basitarsi somewhat yellowish; maculations on axilla and scutellum usually reduced.



*Distribution:* ARGENTINA: Chubut (0–300 m a.s.l.). Recorded from the Patagonian steppe ecoregion (Fig. 583).

*Phenology:* January, April.

*Floral records:* ASTERACEAE: *Grindelia* sp.

#### **ANTHIDIUM DANUNCIAE SP. NOV.**

FEMALE, FIGS 25, 69, 149; MALE, FIGS 45, 228, 296, 353, 506, 566

*Diagnosis:* Superficially this species resembles *A. adriani*, *A. rubripes*, and *A. sparsipunctatum* sp. nov. in body colour (body black with antenna, tegula, and most segments of legs ferruginous), shape of T6 of the female (Fig. 149), and T7 of the male (Fig. 228). Both sexes of *A. danunciae* sp. nov. can be distinguished from all other NW *Anthidium* by the terga distinctly smooth and shiny, glossy, with broad distal margins, especially in the middle (Fig. 25).

*Description:* *Female.* Body length 11.2 mm; forewing length 7.8 mm. *Structure.* Clypeus weakly convex, projected about 0.3× width of compound eye in profile, distal margin slightly thick, wavy, distinctly projected sublaterally (Fig. 69); mandible with six teeth; labrum without basal protuberances, preapical projections small, nearly tuberculiform; F1 twice as long as broad, about as long as combined lengths of F2 and F3. Tibial carina absent. T6 straight in profile, lateral spine small, acute, preapical carina minutely crenulate, depressed apical rim projecting on 0.4× of gently convex distal margin (Fig. 149). *Coloration.* Black, except ferruginous on antenna (darker on superior margin of distal segments), tegula, apices of femora, and remaining segments of legs; cream or yellow maculations as follows: oval spot laterally on vertex and medially interrupted bands on T1–T5, closer on apical terga. Wings light orange basally, brownish distally, with weak coppery reflections; veins ferruginous basally (including stigma and prestigma), dark brown distally. *Pubescence.* Black, except yellowish to ferruginous hairs on scape and ferruginous areas of legs; whitish hairs on dorsum of mesosoma, pronotal lobe, mesepisternum, metepisternum, sides of propodeum, and sides of T1 and T2. Fore basitarsus with sparse fringe of long hairs ( $\geq 2\times$  basitarsal width) along posterior margin. *Sculpturing.* Propodeal triangle weakly shiny, finely lineolate to imbricate. T1–T5 with weakly elevated discal areas, glossy, smooth and shiny between sparse punctures ( $2\text{--}4\times$  PW); depressed marginal zones largely impunctate medially, laterally more densely punctate than on discs ( $1\text{--}2\times$  PW); distal margins smooth, shiny, laterally narrow ( $1\text{--}2\times$  PW), progressively wider towards middle.

*Male.* Body length 12.3 mm; forewing length 8.8 mm. *Structure.* Labrum without preapical projections or tubercles; F1 1.8× longer than broad, shorter ( $0.7\times$ ) than combined lengths of F2 and F3. Lateral spine of T6 straight, about as long as median spine of T7; lateral lobe of T7 subrectangular to nearly triangular, about 1.3× wider than distance between inner margin and median spine (Fig. 228); S4 with small tuft of short black hairs (about one-eighth sternal width) on straight distal margin (Fig. 296); S6, in ventral view, with gently convex basal margin, laterally with small, sharp, ventrally directed angle, distal margin straight or nearly straight (Fig. 353); S7 hemisternite as in Figure 45; S8 with short, curved apical process, basally broad, slightly more than one-third width of distal margin (Fig. 506). Genitalia: gonostylus robust, 3.0× longer than broad; volsella small, slightly less than half of gonostylar length, elongate, somewhat digitiform, ventrally curved in profile; penis valve about as long as gonostylus, long, narrow, pointed, blade-like, dorsoapical patch of short hairs absent, medial projection large, distinct (Fig. 566). *Coloration.* As in female, except yellow on outer surface of mandible and clypeus, except basally (sometimes with pair of black spots); F2–F11 darkened. *Pubescence.* As in female, except whitish hairs on face, tibiae, tarsi, and disc of T2.

*Holotype:* ♀, PERU: San Jeronimo, 10 km E Cusco, Feb.–March 1978 // P.M. Marsh collector (USNM).

*Paratypes:* 4 males. Same data as holotype (USNM, BBSL).

*Distribution:* PERU: Cusco (3200 m a.s.l.); Central Andean wet puna.

*Phenology:* February, March.

*Etymology:* This species is dedicated to our friend and colleague Dr Danuncia Urban, who has contributed significantly to the knowledge of the neotropical Anthidiini.

#### **ANTHIDIUM DECASPILUM MOURE, 1957**

FEMALE, FIGS 70, 150; MALE, FIGS 229, 297, 354, 430, 507

*Anthidium decaspilum* Moure, 1957: 211 (lectotype: DZUP; ♀, Baños del Toro, Elqui, Chile); Urban, 2003: 20 (type designation).

*Anthidium falsificum* Moure, 1957: 214 (lectotype: DZUP; ♀, Baños del Toro, Elqui, Chile); Urban, 2003: 21 (type designation) (**new synonym**).

**Diagnosis:** The female of this species can be recognized by the following combination of characters: clypeus with distal margin thick, usually broad and flattened medially (Fig. 70); hind tibia and basitarsus with outer surfaces sparsely covered with distinctly shorter and thicker hairs than those on anterior margin; tibial carina absent; sternal scopa black; and T6 gently elevated basally along midline, somewhat depressed preapically, with small but distinct lateral angle or spine, preapical carina distinct, depressed medioapical rim strongly projecting on less than half of weakly convex distal margin (Fig. 150). Maculated specimens of *A. decaspilum* can be confused with *A. rubripes* and related species, but can be easily separated by the clypeal margin, modified hairs on outer surface of hind basitarsus, and shape of T6. The male is most similar to that of *A. mapuche* sp. nov. in the T7 with lateral lobe subtriangular, shape of S4–S8, and genitalia. However, in *A. decaspilum*, S4 has a slightly broader apical brush (0.28–0.30× versus 0.20× sternal width in *A. mapuche* sp. nov., compare Figs 297 and 311), and S6 has less acute lateral projections and a more projected distal margin medially (compare Figs 354 and 44).

**Description: Female.** Body length 9.2–13.8 mm; forewing length 7.1–9.2 mm. **Structure.** Clypeus weakly convex, projected about 0.4× width of compound eye in profile, distal margin thick, usually broad, flattened medially, sublaterally projected (Fig. 70); mandible with six teeth; labrum without basal protuberances, preapical projections large, distinctly curved upwards; F1 about twice as long as broad, shorter (~0.8×) than combined lengths of F2 and F3. Tibial carina absent. T6 gently elevated basally along midline, somewhat depressed preapically, with small but distinct lateral angle or spine, preapical carina distinct, minutely crenulate, depressed apical rim translucent, projecting on nearly median half or less of gently convex distal margin (Fig. 150). **Coloration.** Black, except ferruginous on outer surface of mandible (sometimes darkened), antenna (darker on superior margin of distal segments), pronotal lobe, tegula, most of femora, and remaining segments of legs; yellow or cream maculations as follows: complete broad band on vertex (sometimes reduced to rounded or oval spot behind compound eye), T1–T4 with medially interrupted bands, closer on apical terga, laterally weakly notched on posterior margin (bands sometimes reduced to lateral spots or completely absent on all terga), and T5 with two submedian spots. Wings light orange basally, brownish distally, with weak greenish, violet, and coppery reflections; veins ferruginous basally (including stigma and prestigma), dark brown distally. **Pubescence.** Head and mesosoma with mostly

yellowish to ferruginous hairs (sometimes mostly whitish), except dark-brown to black hairs on clypeus, upper gena, and dark-brown to black areas of legs; whitish hairs on remaining areas of gena, mesepisternum, metepisternum, and sides of propodeum; metasoma with dark brown to black hairs except whitish hairs on sides of basal three terga. Fore basitarsus with sparse fringe of long hairs ( $\geq 2\times$  basitarsal width) along posterior margin. Outer surface of hind tibia and basitarsus sparsely covered with distinctly shorter, thicker hairs than those on anterior margin. **Sculpturing.** Propodeal triangle weakly shiny, lineolate to imbricate. T1–T5 with weakly elevated discal areas, weakly shiny to nearly smooth, shiny, somewhat glossy, sparsely punctate (2–4× PW); depressed marginal zones more densely punctate than on discs (1–2× PW); distal margins narrow, about one-quarter to one-third of depressed marginal zone.

**Male.** Body length 13.1–16.2 mm; forewing length 8.2–10.2 mm. **Structure.** F1 1.7× longer than broad, shorter (0.7×) than combined lengths of F2 and F3; lateral spine of T6 gently curved, about as long as median spine of T7; lateral lobe of T7 subtriangular, inner margin sometimes angled, about 1.5× broader than distance between inner margin and median spine (Fig. 229); S4 with apical brush of short hairs on median one-quarter to one-third of gently convex distal margin (Fig. 297); S6, in ventral view, with basal margin straight or nearly straight, lateral lobe long, pointed, laterally directed, distal margin medially projecting into blunt apex (Fig. 354); S7 hemisternite as in Fig 430; S8 with short, curved apical process, basally about half width of distal margin (Fig. 507). **Genitalia:** gonostylus robust, 3.0× longer than broad; volsella small, slightly shorter than gonostylar length, subrectangular; penis valve slightly shorter than gonostylus, apex curved, pointed, blade-like, dorsoapical patch of hairs absent, medial projection large, distinct. **Coloration.** As in female, except yellow or cream on outer surface of mandible, clypeus, and inferior paraocular area.

**Distribution:** ARGENTINA: Neuquén, Mendoza, San Juan, Santa Cruz. CHILE: Coquimbo, Valparaíso, Santiago Metropolitan (2700–3800 m a.s.l.). Recorded from Southern Andean and Patagonian steppe and High Monte ecoregions.

**Phenology:** September, late November–early February.

**Floral records:** FABACEAE: *Adesmia* sp. ONAGRACEAE: *Oenothera* sp.

**Comments:** Both sexes of this species vary in colour, length of body pubescence, and extent of yellow

markings on the vertex and terga. Specimens from regions V and VI of Chile (Mantagua and Cordillera) have longer and denser pubescence on the mesosoma and terga compared with specimens from other localities, with pubescence on dorsum of head and mesosoma mostly ferruginous. Moure (1957) described *A. falsificum* (with the same type locality as *A. decaspilum*) from specimens with abundant whitish pubescence on the head and mesosoma, and reduced maculations on the vertex and terga. In typical *A. decaspilum*, as described, the head and mesosoma are mostly covered by yellowish to ferruginous hairs, the vertex has a complete broad band, and all terga, except for the terminal segments, have medially interrupted bands. Besides these differences in colour, the only other distinction is T6 of the female with a slightly more reduced preapical carina and pointed depressed apical rim; there were no distinct differences in male T7, S6–S8, and genitalia. Thus, we do not recognize *A. falsificum* as a distinct species. The only other variation of possible taxonomic importance is the presence of a slightly broader apical brush of S4 in some males from Mendoza (Argentina). Given the similarity between the males of *A. decaspilum* and *A. mapuche* sp. nov., the records of *A. decaspilum* from southern Argentina indicated by Urban (2002) need to be confirmed.

*ANTHIDIUM DECEPTUM* SMITH, 1879

FEMALE, FIGS 71, 151; MALE, FIGS 230, 355, 431, 508; MAP, FIG. 583

*Anthidium deceptum* Smith, 1879: 91 (holotype: BMNH 17A.1890; ♂, Peru).

*Anthidium aricensis* Friese, 1904a: 182 (lectotype: ZMB; ♀, Arica, Chile); Urban & Moure, 2007: 879 (synonymy with *deceptum*); (**new lectotype designation**).

*Anthidium simulans* Cockerell, 1926a: 217 (holotype: AMNH; ♂, Tingo, Arequipa, Peru); Urban & Moure, 2007: 879 (synonymy with *deceptum*).

**Diagnosis:** Superficially, the female of this species resembles that of *A. cuzcoense* in the following combination of characters: body colour (dark brown to black, with T1–T5 each with four yellow spots); fore and middle basitarsi with outer surfaces densely covered by dense tomentum; hind tibia with carina; and terga weakly shiny. However, *A. deceptum* can be easily separated from *A. cuzcoense* by female T6 with distinct lateral and submedian spines (Fig. 151); male T7 with lateral lobe spiniform (Fig. 230); male S4 without apical hair brush; and male S6 with distal margin medially sinuous (Fig. 355).

**Description:** *Female.* Body length 7.7–10.8 mm; forewing length 6.6–8.5 mm. **Structure.** Clypeus weakly convex, projected about 0.4× width of compound eye in profile, distal margin thin, straight, two lateral-most tubercles usually distinctly projected (Fig. 71); labrum with basal protuberances low, separated by about width of protuberance, preapical projections large, distinctly curved upwards; mandible with six or seven teeth; F1 about twice as long as broad, shorter (0.8×) than combined lengths of F2 and F3. Tibial carina present. T6 straight in profile, lateral spine small but distinct, acute, preapical carina absent, distal margin concave laterally, medially truncate between distinct submedian spines, depressed apical rim visible between submedian spines, median emargination distinct (Fig. 151). **Coloration.** Dark brown to black, except light ferruginous on distitarsi; yellow maculations as follows: outer surface of mandible, clypeus, except distal margin and basal W-shaped spot (sometimes broadly interrupted along midline), broad, short band laterally on vertex, tegula except in centre, continuous broad band on anterolateral and lateral margins of scutum (sometimes reduced), axilla, distal margin of scutellum, except medially, small spot on ventrolateral surface of hind coxa (usually reduced or absent), band on inferior and superior margins of femora apically (usually reduced on fore femur), outer surfaces of tibiae (sometimes reduced on hind tibia), outer surface of hind basitarsus, T1–T5 each with four large spots, and T6, except margins and along midline. Wings hyaline, slightly brownish; veins and stigma dark brown. **Pubescence.** Whitish, except light-brown to ferruginous hairs on vertex, dorsum of mesosoma, inner surfaces of tarsi, and terga. Outer surfaces of basitarsi densely covered by tomentum (integument not visible among hairs). **Sculpturing.** Propodeal triangle dull, finely imbricate. T1–T5 with weakly elevated discal areas, weakly shiny, weakly lineolate or imbricate between punctures (2–4× PW); depressed marginal zones more densely punctate than on discs (1–2× PW); distal margins narrow (1–2× PW), little differentiated from rest of depressed marginal zone.

**Male.** Body length 11.5–14.6 mm; forewing length 8.6–10.3 mm. **Structure.** Labrum without preapical projections; F1 1.7× longer than broad, shorter (0.7×) than combined lengths of F2 and F3. Lateral spine of T6 strongly curved, longer, stouter than median spine of T7; lateral lobe of T7 spiniform, ventromedial margin produced, sometimes visible as strong inner angle in dorsal view (Fig. 230); S4 without distinct apical brush of hairs, at most with some thick, dense hairs medially, distal margin gently convex, nearly straight; S6, in ventral view, with basal margin straight, lateral spine small, sharp, ventrally directed, distal margin sinuous (Fig. 355); S7 hemisternite as in



Figure 431; S8 with narrow, short, gently curved apical process, basally broad, about one-third width of distal margin (Fig. 508). Genitalia: gonostylus robust,  $2.3\times$  longer than broad; volsella very small, about one-sixth of gonostylar length, subquadrate; penis valve slightly shorter than gonostylus, apex long, blade-like, pointed, strongly curved, medially projecting into distinct lobe on dorsal margin, dorsoapical patch of hairs absent, medial projection large, distinct. *Coloration*. As in female, except yellow maculations as follows: clypeus and basitarsi entirely; maculations on femora and scutum usually reduced or absent; T6 usually with two large submedian spots, sometimes with small lateral spot; T7 sometimes with two lateral spots. *Pubescence*. Inner surface of tarsi and disc of terga usually with whitish hairs. *Sculpturing*. Terga slightly shinier, with broader distal margins than in female, about one-third width of depressed marginal zone.

*Distribution*: CHILE: Arica and Parinacota, Tarapacá, Antofagasta. PERU: Arequipa, Ica, Lima, Moquegua and Tacna (300–3500 m a.s.l.). Present in Atacama and Sechura deserts, and Central Andean dry puna ecoregions (Fig. 583).

*Phenology*: Year round. Recorded from all months except June and August.

*Floral record*: ASTERACEAE: *Baccharis* sp.; *Encelia* sp. FABACEAE: *Medicago sativa*.

*Comments*: Friese (1904a) did not state the number of specimens on which he based the description of *A. aricensis*. He simply mentioned that this species was described from several females from Arica. Therefore, to stabilize the name we herein designate a lectotype. The complete label data for the lectotype of *A. aricensis* are as follows: 'Chile // *Anthidium aricensis* 1904 Friese det ♀ // Type (red label) // Zool. Mus. Berlin // ♀ Lectotype *Anthidium aricensis* Friese Des. V.H. Gonzalez & T. Griswold 2009' (red label).

#### ***ANTHIDIUM DUOMARGINATUM* SP. NOV.**

FEMALE, FIGS 22, 23, 72, 152; MALE, FIGS 231, 298, 356, 432, 509, 567; MAP, FIG. 578

*Diagnosis*: Both sexes of *A. duomarginatum* sp. nov. are easily separated from all other NW *Anthidium* by T1–T5 with discal areas shiny, strongly elevated, and distal margins distinctly thickened, doubly carinate (Figs 22, 23). Some pale-haired female specimens of *A. atrifrons*, with extensive yellow markings on the body, and terga with depressed marginal zones coarsely punctate, may be confused with this species;

however, the fore and mid basitarsi of *A. atrifrons* are more densely covered by tomentum on the outer surfaces than in *A. duomarginatum* sp. nov., such that these segments appear more robust. The depressed apical rim of T6 is also different between these species, progressively disappearing about halfway between the median emargination and lateral angle in *A. atrifrons* and completely visible across entire distal margin in *A. duomarginatum* sp. nov. The shape of male S6 also resembles that of *A. atrifrons* (compare Figs 336 and 356), but the submedian emargination of T7, between the lateral lobe and median spine, is much broader in *A. atrifrons* (Fig. 211 compared with Fig. 231). The male of *A. duomarginatum* sp. nov. can be confused with that of *A. mormonum* because of the strongly elevated discal areas of T1–T5, but the shape of S6 and S8 are completely different (compare Figs 356 and 509 with Figs 378 and 532).

*Description (paratypes in parentheses): Female*. Body length 11.1 mm (10.0–12.0); forewing length 7.7 mm (7.7–8.5). *Structure*. Clypeus prominently convex, projected about  $0.5\times$  width of compound eye in profile, distal margin thin, straight between the two lateral-most tubercles (Fig. 72); mandible with six teeth (sometimes five); labrum without basal protuberances, preapical projections large, distinctly curved upwards. Tibial carina absent. T6 distinctly convex in profile, preapical carina absent, depressed apical rim projecting on entire, somewhat truncate distal margin (Fig. 152). *Coloration*. Black, except dark brown on antenna; light-brown distitarsi; yellow maculations as follows: outer surface of mandible (sometimes reduced to absent), apicolateral areas of clypeus (usually on entire distal half of clypeus and lower paraocular area, often reduced in the latter), rounded to oval spot laterally on vertex (sometimes absent or extending medially to level of lateral ocellus), pronotal lobe, tegula except on median third (sometimes entire tegula except on disc), costal sclerite, short (less than one-third tegular length), narrow ( $0.5\times$  OD) band on lateral margin of scutum next to tegula (sometimes continuous band on anterolateral and lateral margins of scutum), axilla (usually reduced), distal third of scutellum except medially, superior margin of hind femur distally (sometimes also on lower margins of fore and middle femora distally, usually absent), broad band ( $1.2\text{--}1.5\times$  OD) on outer surfaces of fore and mid tibiae and posterior margin of hind tibia, outer surface of hind basitarsus, small spot laterally on hind coxa, T1 with four short bands (usually with medially interrupted band, laterally deeply notched on posterior margin), and T2–T6 with complete bands, narrowed medially, laterally weakly notched on anterior margin (sometimes weakly interrupted

medially), broadest on T6. *Pubescence*. Whitish, except light ferruginous hairs on inner surface of tarsi (also on vertex, scutum, axilla, and scutellum in some paratypes); brownish hairs on centre of sternal scopa. Clypeus with some apically curved or wavy hairs (hairs with broken off apices in holotype). Outer surfaces of fore and mid basitarsi densely covered by tomentum (integument not visible among hairs). *Sculpturing*. Propodeal triangle finely, weakly lineolate, nearly smooth, shiny. T1–T5 with strongly elevated discal areas, finely, weakly lineolate, nearly smooth, shiny between punctures (1–2× PW); depressed marginal zones coarsely, densely punctate ( $\leq 1\times$  PW); distal margins smooth, shiny, narrow (2–3× PW), distinctly thickened, doubly carinate.

*Male*. Body length 10.0–13.8 mm; forewing length 8.2–9.2 mm. *Structure*. Labrum with preapical projections larger than in female; F1 1.5× longer than broad, shorter (0.6×) than combined lengths of F2 and F3. Lateral spine of T6 straight or nearly straight, about as long as median spine of T7; lateral lobe of T7 rounded, about 1.5× broader than semicircular submedian emargination, outer margin convex (Fig. 231); S4 with broad (about one-third sternal width), dense, black or reddish brown brush of short hairs on weakly concave distal margin (Fig. 298); S6, in ventral view, with basal margin gently convex to nearly straight, outer margin of acute lateral lobe concave, thus apex laterally directed, median lobe tapering apically, narrowly truncate (Fig. 356); S7 hemisternite as in Figure 432; S8 with broad apical process, basally about half or less width of distal margin, deeply bifid apically, with pointed apex ventrally bent ( $\sim 130^\circ$ ) in profile (Fig. 509). Genitalia: gonostylus robust, 3.8× longer than broad; volsella small, about one-third of gonostylar length, triangular in ventral view, gently rounded apically, somewhat projected ventrally, as seen in profile; penis valve about half of gonostylar length, apex broad, flattened, dorsoapical patch of hairs present, medial projection small (Fig. 567). *Coloration*. As in female, except cream or yellow maculations as follows: outer surface of mandible, outer surface of scape (usually absent), clypeus, except sometimes on distal margin, inferior paraocular area, outer surfaces of tibiae, fore and mid basitarsi, complete broad band on T7, as in preceding terga (sometimes broadly interrupted medially or completely absent), and small spot laterally on S2–S5 (sometimes absent); maculations on scutum, axilla, and scutellum usually absent. *Pubescence*. Sterna with whitish hairs. *Sculpturing*. Terga smoother, shinier, with sparser punctures on discs (2–3× PW) and depressed marginal zones (1–2× PW) than in female; distal margins broader (4–6× PW), not as distinctly thickened as in female.

*Holotype*: ♀, USA: Utah, Garfield Co., Lonesome Beaver, Henry Mts, 38°07.26'N, 110°46.67'W, 17 June 2000, F.D. Parker, Malaise (BBSL).

*Paratypes*: 38 females, 34 males. USA: New Mexico, Socorro Co., 7♂, Magdalena, 12 mi SE, Water Canyon, 15 Jun 1979; Utah, Garfield Co., 14♂, Henry Mountains, Lonesome Beaver, 17 Jun 2000, F.D. Parker; 1♀, Panguitch Lake, 18 Aug 1995, F.D. Parker, V.J. Tepedino; Iron Co., 1♀, Bone Draw, 13 Jul 1955, D.W. Davis, G.E. Knowlton; Kane Co., 1♀, Red Wash, 2.6 mi SSE Carly Knoll, 6 Jun 2001, *Calochortus nuttallii*, R. Andrus; Piute Co., 1♀, Beaver-Junction Summit, 23 Jun 1971, G.E. Bohart, P.F. Torchio; 2♀, Junction, 10 mi W, 23 Jun 1971, G.E. Bohart, P.F. Torchio; San Juan Co., 3♀, Cedar Point, 15 Jul 1952, G.E. Bohart, G.E. Knowlton; Sevier Co., 1♀, Last Chance Road, 16 mi N Loa, 14 Aug 1995, *Cleome*, F.D. Parker, V.J. Tepedino; Washington Co., 1♂, Firepit Kn., 0.72 mi E, 6 Jun 2006, B. Hays, F. Nicklen; 3♀, Spendllove Kn., 0.28 mi NNE, 22 Jun 2006, B. Hays, F. Nicklen; 3♀, Spendllove Kn., 0.28 mi NNE, 13 Jun 2007, H. Ikerd, K. Davidson; 1♂, Spendllove Kn., 0.40 mi NE, 22 Jun 2006, *Lotus utahensis*, B. Hays; 1♂, Spendllove Kn., 0.40 mi NE, 13 Jun 2006, *Lotus utahensis*, F. Nicklen; 1♂, Stave Spr., 0.50 mi NNW, 23 Jun 2006, *Phacelia heterophylla*, B. Hays; 1♀, Stave Spr., 0.50 mi NNW, 12 Jun 2006, B. Hays, F. Nicklen; 1♂, Stave Spr., 0.50 mi NNW, 4 Jun 2007, H. Ikerd; 1♂, Stave Spr., 0.50 mi NNW, 2 Jul 2007, *Phacelia heterophylla*, H. Ikerd; 1♂, Stave Spr., 0.50 mi NNW, 4 Jun 2007, *Phacelia heterophylla*, H. Ikerd; 1♀, Stave Spr., 0.50 mi NNW, 2 Jul 2007, H. Ikerd, K. Davidson; 2♀, Stave Spr., 0.50 mi NNW, 4 Jun 2007, H. Ikerd, K. Davidson; 1♂, Stave Spr., 0.50 mi NNW, 4 Jun 2007, *Phacelia heterophylla*, K. Davidson; 1♂, Stave Spr., 0.80 mi WSW, 19 Jun 2007, H. Ikerd; 1♀, Stave Spr., 1.12 mi WSW, 20 Jun 2006, *Phacelia heterophylla*, B. Hays; 1♂, Stave Spr., 1.12 mi WSW, 9 Jun 2006, *Phacelia*, B. Hays; 1♀, Stave Spr., 1.12 mi WSW, 20 Jun 2006, B. Hays, F. Nicklen; 1♀, Stave Spr., 1.12 mi WSW, 7 Jul 2006, B. Hays, F. Nicklen; 1♂, Stave Spr., 1.12 mi WSW, 19 Jun 2007, H. Ikerd; 1♀, Lemmon Spr., 0.63 mi NNW, 29 Jun 2006, *Lotus utahensis*, C. Decker; 1♂, Lemmon Spr., 0.63 mi NNW, 21 Jun 2007, *Lotus utahensis*, H. Ikerd; 1♀, Lemmon Spr., 0.80 mi NW, 25 Jun 2007, H. Ikerd, K. Davidson; 1♀, Crystal Creek, 8–19 Aug 1981, C.R. Nelson; 1♀, Pine Valley, 3 Jul 1993, G. Bryant; 1♀, Pine Valley, 11 Jul 1968, G.E. Knowlton (BBSL, BYUC, SEMC, USNM).

*Distribution*: Western USA: southern Utah, northern Arizona, northern New Mexico; mountains in and on the margins of the Colorado Plateau (1200–3400 m a.s.l.; 93% of records below 2800 m a.s.l.).

Found in the Colorado Plateau shrublands, Wasatch montane forests, and Arizona Mountains forests ecoregions (Fig. 578).

*Phenology*: May–mid August; majority of records (84%) in June.

*Floral records*: ASTERACEAE: *Erigeron rhizomatus*, *Hymenopappus* sp. BORAGINACEAE: *Phacelia heterophylla*, *Phacelia magellanica*. CARYOPHYLLACEAE: *Arenaria* sp. CLEOMACEAE: *Cleome* sp. FABACEAE: *Lotus utahensis*, *Lotus wrightii*; *Lupinus sericeus*, *Melilotus* sp.; *Psoralea tenuiflorae*. GERANACEAE: *Geranium atropurpureum*. IRIDACEAE: *Iris* sp. LAMIACEAE: *Marrubium vulgare*. LILIACEAE: *Calochortus nuttallii*. PLANTAGINACEAE: *Penstemon linarioides*.

*Etymology*: The specific epithet refers to the distinct, doubly carinate distal margins of T1–T5 present in both sexes.

*Comments*: Some paratypes of both sexes from Garfield County, in south central Utah, have the discal areas of T1–T5 weakly elevated, with thinner distal margins. These specimens can be confused with some pale-haired *A. atrifrons*, but they can be separated from that species by the shape of T6 in the female and the configuration of T7, S6, and S8 in the male.

#### *ANTHIDIUM EDWARDSII* CRESSON, 1878

FEMALE, FIGS 73, 153; MALE, FIGS 232, 299, 357, 433, 510; MAP, FIG. 578

*Anthidium edwardsii* Cresson, 1878: 112 (holotype: ANSP 2389; ♂, California, USA); Cresson, 1916: 117 (type designation).

*Anthidium 3-cuspidum* [sic] Provancher, 1896: 10 (holotype: MPQ; ♂, Los Angeles Co., California, USA; not examined); Cockerell, 1904b: 59 (*Anthidium tricuspdatum*; emendation); Schwarz, 1927c: 2 (synonymy with *edwardsii*).

*Anthidium hesperium* Swenk, 1914: 18–19 (holotype: UNSM; ♀, Palo Alto, California, USA); Schwarz, 1927c: 2 (synonymy with *edwardsii*).

*Anthidium depressum* Schwarz, 1927b: 4 (holotype: USNM 40164; ♂, Coulee City, Washington, USA); Schwarz, 1927c: 1 (synonymy with *edwardsii*).

*Diagnosis*: This species is most similar to *A. placitum* in the female clypeus (Fig. 73) weakly convex, with distinct acute lateral teeth on the apical margin; however, T6 is not laterally projected into a blunt tooth (Fig. 153) and the depressed apical rim is not clearly visible in dorsal view, as in *A. placitum* (Fig. 188). Also, the outer surfaces of basitarsi are not densely covered by tomentum (integument largely

visible among hairs) and the terga are dull, finely and densely punctate, with discal areas weakly elevated. In *A. placitum* the outer surfaces of basitarsi are densely covered by tomentum (integument not visible among hairs), terga are smooth and shiny between sparse punctures, and the discal areas of T1–T5 are strongly elevated, especially on T3–T5. The male is easily distinguished from all other North American *Anthidium* by T7 with lateral lobe narrow, pointed (Fig. 232), S4 with well-developed reddish brown apical brush (Fig. 299), and S6 with lateral lobe laterally directed (Fig. 357).

*Description*: *Female*. Body length 8.5–10.9 mm; forewing length 6.2–8.0 mm. *Structure*. Clypeus prominently convex, projected about 0.4× width of compound eye in profile, distal margin thin, medially emarginate, with acute sublateral teeth or tubercles (Fig. 73); mandible with five teeth; labrum without basal protuberances, preapical projections large, distinctly curved upwards; F1 1.7× longer than broad, slightly shorter (0.8×) than combined lengths of F2 and F3. Tibial carina weak or absent. T6 straight in profile, slightly swollen preapically, without distinct lateral angle, preapical carina minutely crenulate, depressed apical rim narrow (obscured by hairs, not clearly visible in dorsal view), projecting on nearly entire distal margin (Fig. 153). *Coloration*. Black, except dark brown on antenna, legs (distitarsi ferruginous), and metasoma; yellow maculations as follows: outer surface of mandible, clypeus except distal margin and along midline, rounded to oval spot laterally on vertex (sometimes extending medially to level of lateral ocellus), pronotal lobe, tegula except on median third, costal sclerite, short, narrow band on lateral margin of scutum next to tegula (sometimes continuous band on anterolateral and lateral margins of scutum), axilla (usually reduced), distal third of scutellum, except medially, lower and superior margins of femora (usually reduced to apex), outer surfaces of tibiae and basitarsi, small spot laterally on hind coxa, and complete bands on terga (sometimes weakly interrupted medially, especially on T1), narrowed medially, laterally weakly notched on posterior (T1) or anterior margin (remaining terga). *Pubescence*. Whitish, except yellowish or brownish hairs on clypeus, vertex, inner surfaces of tarsi, depressed marginal zones of T1–T5, and S6. Supraclypeal area with stiff, semi-erect, apically hooked or wavy hairs, longer than those modified hairs on clypeus. Outer surface of basitarsi not densely covered by tomentum (integument largely visible among hairs). *Sculpturing*. Propodeal triangle dull, finely lineolate. T1–T5 with weakly elevated discal areas, coarsely, densely punctate ( $\leq 1\times$  PW), smooth and weakly shiny between punctures; depressed



marginal zones as coarsely, densely punctate as on discs; distal margins smooth, shiny, very narrow (1–2× PW), distinctly thickened, doubly carinate.

**Male.** Body length 11.5–13.1 mm; forewing length 7.7–9.2 mm. **Structure.** Labrum with preapical projections larger than in female; F1 1.6× longer than broad, shorter (0.8×) than combined lengths of F2 and F3. Lateral spine of T6 straight or nearly straight, about as long as median spine of T7; lateral lobe of T7 tapering apically, usually narrower than distance between inner margin and median spine, outer margin straight, inner margin sometimes angled, thus apex somewhat arrow-shaped (Fig. 232); S4 with broad (about one-third sternal width), dense, reddish brown brush of short hairs on weakly concave distal margin (Fig. 299); S6, in ventral view, slightly projected medially, lateral spine small, laterally directed, median lobe rectangular, broader than long (Fig. 357); S7 hemisternite somewhat apically truncate (Fig. 433); S8 with long, narrow apical process, gently curved in profile, deeply bifid apically (Fig. 510). **Genitalia:** gonostylus robust, 3.8× longer than broad; volsella small, about one-third of gonostylar length, triangular in ventral view, gently rounded apically, somewhat projected ventrally, as seen in profile; penis valve about half of gonostylar length, apex broad, dorsoapical patch of hairs present, medial projection small. **Coloration.** As in female, except yellow on clypeus; ferruginous on distitarsi and often on metasoma; maculations on scutum usually reduced or absent. **Sculpturing.** Terga shinier, with broader (2–3× PW) distal margins than in female.

**Distribution:** Western USA: widespread in Central Valley, Coast Ranges, and foothills of the Sierra Nevada of California, also found sporadically in Oregon, central Washington, southern Idaho, and northern Utah (0–1900 m a.s.l.; 88% of records below 1000 m a.s.l.). One anomalous record from St George, Utah. Ecoregions include California chaparral and woodlands, California Central Valley grasslands, Sierra Nevada forests, Northern California coastal forests, Klamath–Siskiyou forests, Snake–Columbia shrub steppe and Great Basin shrub steppe (Fig. 578).

**Phenology:** April–October; most records (94%) from second half of May through first half of September.

**Floral records:** APIACEAE: *Eryngium articulatum*. ASCLEPIADACEAE: *Asclepias subulata*. ASTERACEAE: *Achillea millefolium*; *Cirsium* sp.; *Gutierrezia californica*; *Solidago californica*; *Stephanomeria exigua*. BORAGINACEAE: *Heliotropium curassavicum*; *Phacelia distans*, *Phacelia ramosissima*. CLEOMACEAE: *Cleo-*

*mella obtusifolia*; *Wislizenia refracta*. CONVULVACEAE: *Cressa truxillensis* var. *vallicola*. FABACEAE: *Lathyrus splendens*; *Lotus purshianus*, *Lotus scoparius*, *Medicago sativa*; *Trifolium obtusifolium*, *Trifolium pratense*, *Trifolium repens*, *Trifolium variegatum*. LAMIACEAE: *Marrubium vulgare*; *Scutellaria bolanderi*; *Trichostema lanatum*, *Trichostema lanceolatum*, *Trichostema laxum*. ONAGRACEAE: *Clarkia speciosa*. OROBANCHACEAE: *Cordylanthus maritimus*, *Cordylanthus mollis*, *Cordylanthus tenuis*. PLANTAGINACEAE: *Penstemon* sp. POLYGONACEAE: *Eriogonum gracile*. VERBENACEAE: *Verbena lasiostachys*.

**Biology:** Found nesting in dead bamboo (Grigarick & Stange, 1968); a meloid beetle is recorded as a parasite (Hurd, 1979).

**Comments:** In some specimens of both sexes the tibial carina is weakly suggested, often difficult to see because of the yellow integument. For this reason, the male of this species appears twice in the key. The type of *A. 3-cuspidum* was not examined.

#### ANTHIDIUM EDWINI RUIZ, 1935

FEMALE, FIGS 74, 154; MALE, FIGS 233, 300, 358, 434, 511

*Anthidium edwini* Ruiz, 1935: 276 (lectotype: DZUP; ♂, Biobio, Chile); Urban & Moure, 2007: 879 (type designation).

**Diagnosis:** Both sexes of this species are very distinctive. The female is easily distinguished from all NW *Anthidium* by T6 strongly protuberant medially on disc, with a broad and deep median emargination and a distinctive depressed apical rim projecting on median half of distal margin (Fig. 154). The male resembles that of the North American species *A. formosum* and *A. illustre* in the greatly elongate penis valve, extending anteriorly over S6, clearly visible without dissection (as in Fig. 38). It can be distinguished from those species by T7 with lateral lobe short, subtriangular (Fig. 233), S3 with apical brush broad (as well as on S4), and S6 with lateral lobes long, pointed, ventromedially directed (Fig. 358).

**Description:** *Female.* Body length 12.3–13.8 mm; forewing length 8.2–8.8 mm. **Structure.** Clypeus weakly convex, projected about 0.4× width of compound eye in profile, distal margin distinctly thick, usually broader medially, sublaterally projected (Fig. 74); mandible with six teeth; labrum without basal protuberances, preapical projections rather small, tuberculiform; F1 about twice as long as broad, about as long as combined lengths of F2 and F3. Tibial carina absent. T6 convex in profile, strongly

protuberant medially, without distinct lateral angle, preapical carina absent, depressed apical rim distinctive, projecting on median half of somewhat truncate distal margin, median emargination broad and deep (Fig. 154). *Coloration*. Black, except ferruginous on antenna (darker on superior margin of distal segments), pronotal lobe, tegula, and legs, excluding coxae, trochanters, and sometimes bases of femora; yellow maculations as follows: outer surface of mandible (sometimes darkened), distal half of clypeus, except medially (sometimes reduced), inferior paraocular area, complete broad band on vertex, medially interrupted bands on T1–T4, closer on apical terga (sometimes laterally notched on posterior margin), and two submedian spots on T5. Wings light orange basally, brownish distally, with weak greenish, violet, and coppery reflections; veins ferruginous basally (including stigma and prestigma), dark brown distally. *Pubescence*. Whitish, except light ferruginous to yellowish hairs on vertex, dorsum of mesosoma, and inner surfaces of tarsi; dark-brown hairs on depressed marginal zones of T1–T5. Outer surfaces of basitarsi sparsely covered by tomentum (integument barely visible among hairs). Fore basitarsus with sparse fringe of long hairs ( $< 2\times$  basitarsal width) along posterior margin. Outer surface of hind tibia covered with distinctly shorter and thicker hairs than those on anterior margin; outer surface of hind basitarsus with unmodified hairs. *Sculpturing*. Propodeal triangle weakly shiny, lineolate to imbricate. T1–T5 with weakly elevated discal areas, smooth, shiny, sparsely punctate ( $2\text{--}3\times$  PW); depressed marginal zones more densely punctate than on discs ( $1\text{--}2\times$  PW); distal margins about one-quarter to one-third of depressed marginal zone, little differentiated from it, broadest on apical terga.

*Male*. Body length 12.3–13.8 mm; forewing length 9.2–10.0 mm. *Structure*. F1  $1.8\times$  longer than broad, shorter ( $0.7\times$ ) than combined lengths of F2 and F3. Lateral spine of T6 nearly straight, shorter, thinner than median spine of T7; lateral lobe of T7 short, subtriangular, basally about as broad as distance between inner margin and median spine, the latter short and stout (Fig. 233); S3 with apical brush of short, dark-brown hairs on  $0.4\times$  of straight distal margin; S4 with apical brush of short, dark-brown hairs on median half of deeply concave distal margin (Fig. 300); S6, in ventral view, with basal margin convex, lateral lobe long, pointed, ventromedially directed lobe, distal margin straight or nearly straight, gently projecting medially (Fig. 358); S7 hemisternite as in Fig. 434; S8 with short, curved, simple apical process, basally about half width of distal margin (Fig. 511). Genitalia: gonostylus robust,  $3.0\times$  longer than broad; volsella small, about one-third of gonostylar length, obliquely truncate; penis

valve with greatly elongate apex, extending anteriorly over S6 to apical brush of S4 (before dissection), dorsoapical patch of hairs absent, medial projection large, distinct. *Coloration*. As in female except yellow on clypeus, anterior surface of scape, and basitarsi; vertex sometimes with broken or reduced band laterally; T5 with medially interrupted band, as in preceding terga.

*Distribution*: CHILE: Maule and Bio-Bío (800–1300 m a.s.l.). Recorded from the Chilean matorral and Valdivian temperate forests ecoregions.

*Phenology*: February, November.

*Floral records*: FABACEAE: *Adesmia* sp.

#### *ANTHIDIUM EMARGINATUM* (SAY, 1824)

FEMALE, FIGS 27, 75, 155; MALE, FIGS 234, 301, 359, 435, 512; MAP, FIG. 578

*Megachile emarginata* Say, 1824: 352. In: Keating, 1824, vol. II (neotype: BBSL; ♀, Kimball, Nebraska, USA; see comments below) (**new neotype designation**).

*Anthidium montivagum* Cresson, 1878: 110 (lectotype: ANSP 2391; ♂, Colorado, USA); Cresson, 1916: 125 (type designation) (**new synonym**).

*Anthidium astragali* Swenk, 1914: 16 (holotype: UNSM; ♂, Sioux Co., Nebraska, USA); Grigarick & Stange, 1968: 21 (synonymy with *emarginatum*).

*Anthidium rhodophorum* Cockerell, 1925b: 623 (holotype: AMNH; ♀, White Rocks, Colorado, USA); Grigarick & Stange, 1968: 21 (synonymy with *emarginatum*).

*Diagnosis*: The female of this species is most similar to that of *A. atrifrons* in the black scopa and terga with discal areas not strongly elevated (Fig. 27), but it can be separated by the fore basitarsus with sparser tomentum on the outer surface and the T6 with complete depressed apical rim, visible across almost its entire width (Fig. 155). Female *A. tenuiflorae* within the range of *A. emarginatum* that have a mostly dark scopa may be mistaken for the latter. They differ in the absence of any light markings on the scutellum (such marks present in *A. tenuiflorae* from Pacific Coast states). The male resembles that of *A. tenuiflorae* in the T7 with narrow, nearly semicircular emargination, but it can be separated by the shape of the lateral lobe of S6 (Fig. 359) and the apical process of S8 (Fig. 512).

*Description: Female*. Body length 8.3–10.8 mm; forewing length 5.5–7.5 mm. *Structure*. Clypeus prominently convex, projected about  $0.5\times$  width of

compound eye in profile, distal margin thin, wavy, sometimes gently wavy, two lateralmost tubercles usually more distinctly projected (Fig. 75); mandible with five or six teeth; labrum without basal protuberances, preapical projections large, distinctly curved upwards; F1 1.7× longer than broad, slightly shorter (~0.7×) than combined lengths of F2 and F3. Tibial carina absent. T6 distinctly convex in profile, without distinct lateral angle, preapical carina absent, depressed apical rim projecting on entire, truncate distal margin (Fig. 155). *Coloration*. Black, except dark brown on antenna, mandible, and legs; ivory or yellow maculations as follows: rounded to oval spot laterally on vertex, pronotal lobe, tegula, except on disc, axilla (usually reduced), distal margin of scutellum, except medially (sometimes reduced or absent), outer surfaces of tibiae basally (sometimes on entire surface), complete bands on T1–T4 (usually weakly interrupted medially, especially on T1), narrowed medially, laterally weakly notched on posterior (T1) or anterior margin (remaining terga), T5 usually and T6 occasionally with two submedian spots. Wings hyaline, slightly brownish; veins and stigma dark brown. *Pubescence*. Dark brown to black, except whitish or yellowish hairs on frons, vertex, gena, scutum, pronotal lobe, dorsum of mesepisternum and metepisternum (sometimes entire mesosoma, including outer surface of tibiae), and terga (sometimes on basal three terga only). Outer surfaces of fore and mid basitarsi densely covered by tomentum (integument not visible among hairs). *Sculpturing*. Propodeal triangle weakly lineolate, usually smooth, shiny. T1–T5 with weakly elevated discal areas, usually smooth, shiny between punctures (2–5× PW); depressed marginal zones with punctures about as big as those on discs, coarsely and usually densely punctate (1–2× PW); distal margins with distinct smooth, shiny border (2–3× PW).

*Male*. Body length 9.4–11.1 mm; forewing length 6.5–8.2 mm. *Structure*. F1 1.3× longer than broad, shorter (0.6×) than combined lengths of F2 and F3; labrum with preapical projections larger than in female. Lateral spine of T6 straight or nearly straight, about as long as median spine of T7; lateral lobe of T7 rounded, basally about 1.5× broader than semicircular submedian emargination (between inner margin of lateral lobe and median spine), outer margin convex (Fig. 234); S4 with broad (about one-third of sternal width), dense, black brush of long hairs on weakly concave distal margin (Fig. 301); S6, in ventral view, with gently convex to nearly straight basal margin, lateral lobe acute, somewhat obliquely truncate, median lobe subquadrate, slightly broader than long (Fig. 359); S7 hemisternite pointed on distal margin (Fig. 435); S8 with broad apical process, about one-third width of distal margin, deeply bifid apically,

with pointed lobes ventrally bent in nearly straight angle in profile view (Fig. 512). Genitalia: gonostylus robust, 3.3× longer than broad; volsella small, less than one-third of gonostylar length, obliquely truncate in profile, appearing triangular in ventral view; penis valve about half of gonostylar length, apex broad, flattened, dorsoapical patch of hairs present, medial projection small. *Coloration*. As in female, except ivory or yellow maculations as follows: outer surface of mandible, inferior paraocular area, clypeus, except sometimes apical margin, anterior surface of scape, and outer surfaces of tibiae and basitarsi; T7 sometimes with two large spots. *Pubescence*. Predominantly whitish, except light brown to yellowish hairs on inner surfaces of tarsi; sterna usually with dark-brown to black hairs, sometimes entirely whitish or yellowish.

*Distribution*. USA: eastern parts of California, Oregon, Washington east to Montana, Wyoming, western Nebraska, western Kansas, New Mexico, and western Texas; primarily found at low elevations east of the Cascade Mountains and Sierra Nevada; Finney County in western Kansas is the easternmost locality (300–2400 m a.s.l.). Found almost exclusively in grasslands, Colorado Plateau shrublands, shrub steppe, and Chihuahuan Desert ecoregions (Fig. 578).

*Phenology*: Late March–early September; last half of May through first half of July accounts for 89% of records.

*Floral records*: ASTERACEAE: *Chaenactis douglasii*. BORAGINACEAE: *Nama hispidum*; *Phacelia hastata*, *Phacelia heterophylla*, *Phacelia integrifolia*. BRASSICACEAE: *Sisymbrium altissimum*; *Thelypodium laciniatum*. CACTACEAE: *Pediocactus sileri*; *Sclerocactus mesae-verdae*. FABACEAE: *Astragalus atratus*, *Astragalus bolanderi*, *Astragalus cibarius*, *Astragalus oniciformis*, *Astragalus utahensis*; *Lupinus pusillus*; *Medicago sativa*; *Melilotus alba*, *Melilotus officinalis*; *Oxytropis* sp.; *Psoralea lanceolata*; *Psoralidium lanceolatum*; *Trifolium repens*. LAMIACEAE: *Marrubium vulgare*; *Poliomintha incana*. LOASACEAE: *Mentzelia laevicaulis*. MALVACEAE: *Sphaeralcea grossulariifolia*. ROSACEAE: *Ivesia rhypara*. PLANTAGINACEAE: *Penstemon* sp. POLEMONACEAE: *Gilia* sp. ROSACEAE: *Ivesia rhypara*. SOLANACEAE: *Lycium* sp.

*Biology*: The following biological observations have been published for *A. emarginatum* in the broad sense, and may have been based on what is now *A. atrifrons* (see comments below): Davidson (1895) found several nests in the ground, inside abandoned nests of *Anthophora* (Apidae). The cells and nested plug were made with trichomes of *Pseudognaphalium*



*canescens* and *Pseudognaphalium stramineum* (Asteraceae). The trichome-collecting behaviour from stems of *Cirsium undulatum* was briefly described by Hicks (1926).

**Comments:** It is well known among entomologists that the insect collection of Thomas Say (1787–1834) is largely lost. Say was one of the founders of the Academy of Natural Sciences of Philadelphia (ANSP) and described over 1500 species of insects from specimens that he had collected on various expeditions or had acquired from other collectors (Weiss & Ziegler, 1931; Mallis, 1971; Mawdsley, 1993). Most of Say's specimens were poorly preserved and began to deteriorate from the attack of various insect pests after he moved to New Harmony, Indiana, in 1825. All that remains is a single type of a nymphalid butterfly at the ANSP and 770 specimens, mostly coleopterans, in the Museum of Comparative Zoology (MCZ) at Harvard University. Among the hymenopterans described by Say, only three Ichneumonidae remain in the MCZ (Weiss & Ziegler, 1931; Mawdsley, 1993).

Given that no specimen used in Say's original description of *Megachile emarginata* remains, the designation of a neotype is essential to stabilize the use of that name; however, no preferred specimens are available (i.e. specimens identified by Say but not used in his original description), and the original type locality is uncertain. Say's original description of *M. emarginata* was published in Philadelphia in 1824 as an appendix of a two-volume account of an expedition to the upper central/west of the USA, along the border of Canada. The expedition was led by Major S.H. Long a year earlier, and the book was compiled by W.H. Keating. The book was so widely read that a British firm reprinted it in 1825 (Miles, 1959), creating some confusion regarding the proper citation for the species described by T. Say in that appendix. The British edition did not indicate that it was a second printing, and the page numbers of the appendix were not consecutively numbered, as in the 1824 edition (see Say, 1824, for the correct citation of both volumes).

Say described *M. emarginata* presumably from a single female specimen, and mentioned 'Inhabits Missouri' as the type locality. Given that Missouri, as we know it today, became a state in 1821, it is reasonable to assume that he was referring to the present day Missouri. This idea is strengthened by the fact that in the same paper he often mentioned 'Inhabits Arkansas' as the type locality of other species, suggesting the Arkansas territory as organized in 1819. Thus, it seems that he was well aware of the political reorganization of North America in his time, and that the 1824 publication included insects from locations outside the range of those collected in Long's expedi-

tion. It would be straightforward to choose a specimen from present day Missouri as the neotype of *M. emarginata*, except the species, as it is currently understood (*sensu* Grigarick & Stange, 1968), does not occur in Missouri. The only four species occurring in Missouri or nearby states are *A. psoraleae*, *A. maculifrons*, *A. porterae*, and the new species described herein as *A. michenerorum* sp. nov., none of which entirely match Say's description. The absence of yellow marks on T6 rules out *A. psoraleae* (in addition to other distinctive characters, see below), whereas the presence of yellow on the clypeus and paraocular area rules out the remaining species. Although colour pattern alone may not be a reliable character in species recognition because it varies within and between populations, the colour pattern of T6 and the face in those four eastern *Anthidium* species appears constant, based on the examination of a large number of specimens. We also ran the colour characters mentioned in Say's description in the interactive digital identification key of Discover Life (<http://www.discoverlife.org/>) for North American *Anthidium*. This key allows you to select more than one character from a wide range of diagnostic characters, and includes all known intraspecific variation among species for each of these characters. We were only able to use the following 11 characters in that key. **Head:** (1) paraocular area black; (2) clypeus black; (3) mandible with five and six teeth; (4) mandible black. **Mesosoma:** (5) basitarsi with whitish hairs not obscuring or obscuring the integument on outer surface; (6) mid tibia entirely yellow or with yellow stripe on outer surface; (7) pronotal lobe yellow; (8) scutellum with yellow markings; (9) tegula with yellow markings. **Metasoma:** (10) T5 with transverse yellow band, interrupted in the middle; and (11) T6 with two yellow spots. Only two possible species matched the combination of characters in the description: *A. clypeodentatum* and *A. emarginatum* (as interpreted by Grigarick & Stange, 1968). The female of *A. clypeodentatum* is perhaps the most distinctive species of *Anthidium* in North America. The scape has the posterior surface densely covered with white tomentum (Fig. 14), the clypeus is strongly toothed on the distal margin (Fig. 61), and T6 has the midapical margin narrowly projecting (Fig. 141): the latter two features are only shared by *A. psoraleae*. Given that Say provided other details in his description, such as the number of teeth of the mandible, which are often hard to see unless the mandibles are open, these distinctive characters of *A. clypeodentatum* would have been easily noticed. Furthermore, *A. clypeodentatum* does not occur east of the front range of Colorado. Thus, it seems that the current concept of *A. emarginatum* (*sensu* Grigarick & Stange, 1968), matches Say's original description; however, when Grigarick &

Stange (1968) revised the Californian species of *Anthidium*, they also synonymized several names under *A. emarginatum* that have been applied to colour variants. A careful examination of the type specimens of all synonymized names, as well as non-type specimens, revealed the existence of two morphologically similar species, readily distinguishable by characters in both sexes. Both species occur in the western USA, but one is primarily found at high elevations, whereas the other is found at lower elevations and as far east as western Nebraska and Kansas.

Although the species found in Nebraska and Kansas would seem the logical choice, a possibility of the montane species being Say's true *M. emarginata* may exist. In 1819, Say was appointed as zoologist on an expedition to the Rocky Mountains, where the other species occurs. The account of that expedition, also led by Major Long, was published in 1823. Several thousands of insects were collected but not described in that book (Weiss & Ziegler, 1931). In subsequent years, Say described many of them in a series of publications, each concerning a particular order (see LeConte, 1859). For instance, he treated the Coleoptera in 1823 and he also described insects from other locations, as he did in 1824 when he described *M. emarginata*. The various degrees of accuracy in the type localities provided in that paper are striking. For some species, Say (1823) provided specific locations, particularly for species collected at or nearby camp sites during the expedition, such as 'Engineer Cantonment' or 'Council Bluffs' (in present day Nebraska and Missouri, respectively). For others, he probably did not know the locality, mentioning only 'inhabits the United States'. It is interesting that in the same paper he indicated 'inhabits Missouri' for some species and 'inhabits Missouri Territory' for others, which casts doubt on the accuracy of the type locality of *M. emarginata*. Thus, it is possible that in 1824 Say may have described *M. emarginata* from a mislabelled specimen collected in the 1819 expedition.

We will never know for sure the correct type locality of the specimen described by Say, nor which of the two species included in our current concept of *A. emarginatum* is the correct one; however, based on their distribution, we have chosen the lowland species as the true *A. emarginatum* and resurrect the name of *Anthidium atrifrons* Cresson, 1868 (the oldest name of the long list of synonymies) for the montane species. We chose a female from south-western Nebraska that matches Say's description as the neotype of *M. emarginata*. The complete label data for this specimen are as follows: 'Kimball Co. Nebr. near Kimball. Jul. 6 1983. M.C. Rohde // (red label) ♀ NEOTYPE *Megachile emarginata* T.H. Say Des. V.H. Gonzalez & T. Griswold 2010'.

#### *ANTHIDIUM ESPINOSAI* RUIZ, 1938

FEMALE, FIGS 76, 156; MALE, FIGS 235, 302, 360, 436, 513

*Anthidium espinosai* Ruiz, 1938: 153 (holotype: CSPN; ♀, Baños del Toro, Elqui, Chile; not examined).

**Diagnosis:** Both sexes of this species are similar to those of *A. atacamense* sp. nov. and *A. nigerrimum* (see diagnosis of *A. atacamense* sp. nov.). The female can be easily separated from those species by T6 usually elevated along midline, with a distinct lateral spine, and without a submedian spine (Fig. 156). The male is easily separated from those species by S4 with a distinct apical brush of black hairs on the distal margin (Fig. 302). In addition, the yellow or cream bands on the metasoma are usually reduced or absent in both sexes.

**Description:** *Female.* Body length 9.2–11.5 mm; forewing length 6.9–8.8 mm. **Structure.** Clypeus prominently convex, projected about 0.6× width of compound eye in profile, distal margin thin, gently tuberculate sublaterally (Fig. 76); mandible with seven or eight teeth; labrum without basal protuberances, preapical projections small, tuberculiform; F1 2.2× longer than broad, about as long as combined lengths of F2 and F3. Tibial carina absent. T6 straight in profile, usually elevated along midline, lateral spine distinct, distal margin broadly rounded, with distinct median spine, depressed apical rim absent (Fig. 156). **Coloration.** Black, except ferruginous on outer surface of mandible (sometimes darkened), antenna, except distal flagellomeres darkened (especially apex of F10), tegula, and legs, except coxae, trochanters, and basal two-thirds of femora; yellow or cream maculations as follows: small, oval spot laterally on vertex, and medially interrupted bands on T1–T5, broadly separated (usually reduced or absent). Wings light orange basally, brownish distally, with weak greenish, coppery, or violet reflections; veins ferruginous basally (including stigma and prestigma), dark brown distally. **Pubescence.** Head and mesosoma with whitish hairs, except ferruginous hairs on scape and ferruginous areas of legs; whitish intermingled with darker hairs on face, vertex, scutellum, pronotal lobe, upper portion of mesepisternum and metepisternum, sides of propodeum, coxae, trochanters, and most of femora; dark-brown to black hairs on metasoma, except sides of T1 and T2 with whitish hairs. Outer surface of hind tibia and basitarsus sparsely covered with distinctly shorter and thicker hairs than those on anterior margin. **Sculpturing.** Supraclypeal area impunctate along midline. Propodeal triangle weakly shiny, lineolate to imbricate. T1–T5 with weakly elevated

discal areas, glossy, sparsely punctate (2.0–3.0× PW); depressed marginal zones more densely punctate than on discs (1–2× PW); distal margins about one-sixth to one-third of depressed marginal zone.

*Male.* Body length 12.3 mm; forewing length 9.7 mm. *Structure.* Labrum with preapical projections absent; F1 twice as long as broad, shorter (0.8×) than combined lengths of F2 and F3. Lateral spine of T6 strongly curved, distinctly longer, stouter than lateral lobe and median spine of T7; T7 narrowed apically, lateral lobe spiniform, close, ventral to median spine (Fig. 235); S4 with dense apical brush of long, black hairs on nearly median one-third of gently concave distal margin (Fig. 302); S6, in ventral view, with basal margin strongly convex, lateral lobe absent, distal margin somewhat truncated, with reflexed distal edge on entire margin (Fig. 360); S7 hemisternite as in Figure 436; S8 with distal margin medially projected into small curved apex (Fig. 513). Genitalia: gonostylus robust, 3.0× longer than broad, distinctly narrowed basally; volsella small, about one-third of gonostylar length, obliquely truncate in profile, dorsally projecting into lobe; penis valve about as long as gonostylus, apex digitiform, dorsoapical patch of hairs absent, medial projection large, distinct. *Coloration.* As in female, except yellow or cream maculations on outer surface of mandible, clypeus, and inferior paraocular area; maculations of terga usually absent. *Pubescence.* Face, scape, and posterior surface of fore femur with whitish hairs. *Sculpturing.* Terga with distal margins slightly broader than in female, about one-quarter of depressed marginal zone.

*Distribution:* ARGENTINA: Aconcagua, Mendoza. CHILE: Arica and Parinacota to Santiago Metropolitan (700–3500 m a.s.l.). Primarily found in arid regions. Recorded from the Central Andean puna, Central Andean dry puna, Chilean matorral, Southern Andean steppe, and Valdivian temperate forests ecoregions.

*Phenology:* December–March; majority of records (81%) from January.

*Floral records:* ASTERACEAE: *Hypochaeris taraxacoides*. FABACEAE: *Astragalus bustillosii*. LOASACEAE: *Caiphoora rahmeri*.

*Comments:* Although we were not able to examine the type of this species, we had access to several photographs of the holotype kindly provided by Mr. José Salamanca at the CSPN.

#### *ANTHIDIUM FORMOSUM* CRESSON, 1878

FEMALE, FIGS 77, 157; MALE, FIGS 236, 303, 361, 437, 514; MAP, FIG. 579

*Anthidium formosum* Cresson, 1878: 112–113 (holotype: ANSP 2395; ♂, Colorado, USA); Cresson, 1916: 118 (unnecessary lectotype designation).

*Anthidium conspicuum* Cresson, 1879: 207 (holotype: ANSP 2396; ♀, Nevada, USA); Cresson, 1916: 116 (lectotype designation); Schwarz, 1940: 3 (synonymy with *formosum*).

*Anthidium illustre* var. *consonum* Cresson, 1879: 207 (lectotype: ANSP 2398; ♀, Nevada, USA); Cresson, 1916: 116 (new status and unnecessary lectotype designation).

*Dianthidium balli* Titus, 1902: 170–171 (holotype: INHS; ♀, Ridgeway, Colorado, USA; not examined); Cockerell, 1925a: 366 (synonymy with *conspicuum*).

*Callanthidium formosum pratense* Cockerell, 1925a: 366 (holotype: CAS 1747; ♂, Plumas Co., California, USA).

*Callanthidium formosum*; Michener 1951: 1143; Grigarick & Stange, 1968: 36; Hurd, 1979: 1992.

*Anthidium (Callanthidium) formosum*: Griswold & Michener, 1988: 29–30.

*Diagnosis:* *Anthidium formosum* and *A. illustre* can be distinguished from all other North American *Anthidium* by the combination of a large body size (length > 11 mm), body heavily maculated, female T6 with deep median emargination on distal margin (Fig. 157), and male penis valve greatly elongate (Fig. 38). In addition to the characters indicated in the key, both sexes of *A. formosum* differ from *A. illustre* in the labrum without preapical projections and in the following areas with yellow markings reduced or absent: face, gena, outer surface of mandible, mesepisternum, metepisternum, disc of scutum, and S2–S6; the shapes of S4 and S6 of the male are also distinctive. In *A. illustre*, the preapical labral projections are large in the female but absent in the male; the areas of the body listed above are usually coloured in both sexes, as indicated in the account for that species.

*Description: Female.* Body length 11.5–13.5 mm; forewing length 9.2–10.8 mm. *Structure.* Clypeus prominently convex, projected about 0.5× width of compound eye in profile, distal margin thin, gently concave (Fig. 77); mandible with six teeth; labrum without basal protuberances, preapical projections absent; F1 1.8× longer than broad, slightly shorter (~0.8×) than combined lengths of F2 and F3. Tibial carina absent. T6 gently convex basally in profile, distinctly elevated along midline, lateral spine small, distinct, preapical carina absent, depressed apical rim



absent, distal margin medially projected with deep emargination (Fig. 157). *Coloration*. Dark brown to black, except yellow maculations as follows: clypeus, except along midline, midapical margin of supra-clypeal area (usually absent), broad band on paraocular area (usually narrow, curving inward above antennal socket, often ending below level of middle ocellus, sometimes broken above antennal socket, ending just above it or below lateral ocellus), continuous broad band on upper half of gena and vertex (sometimes medially narrowed or broken), pronotal lobe, anterior half of tegula (usually also on outer border), anterolateral and lateral margins of scutum (usually reduced or absent), axilla (sometimes reduced), distal half of scutellum, except medially, superior surfaces of middle and hind femora distally (sometimes reduced or absent), inferior margins of femora distally (sometimes reduced on fore and hind femora), outer surfaces of tibiae and basitarsi, T1–T5 with medially interrupted bands (sometimes entire on T5), usually notched on posterior margin of T1 and T2, T6 entirely, except distal margin and along midline; distitarsi yellowish or brownish. Wings hyaline, slightly ferruginous, particularly on basal half; veins and stigma dark brown. *Pubescence*. Yellowish to light ferruginous (sometimes with whitish hairs on sides of mesosoma and metasoma). Clypeus with some erect, simple, apically wavy hairs. *Sculpturing*. Propodeal triangle shiny, finely imbricate to lineolate. T1–T5 with weakly elevated discal areas, weakly shiny; depressed marginal zones dull, coarsely, densely punctate ( $\leq 1$  PW); distal margins narrow (2–3 $\times$  PW), little differentiated from depressed marginal zone.

*Male*. Body length 12.8–15.4 mm; forewing length 10.0–11.2 mm. *Structure*. F1 1.5 $\times$  longer than broad, shorter (0.6 $\times$ ) than combined lengths of F2 and F3. Lateral spine of T6 straight or nearly straight, longer than pointed median spine of T7; lateral lobe of T7 about as long as or shorter than median spine, apically curved, outer margin convex, inner margin concave (Fig. 236); S4 with broad (two-thirds sternal width), dark-reddish brown hair brush of long hairs on deeply concave distal margin (Fig. 303); S6, in ventral view, with basal margin strongly biconvex, lateral lobe subquadrate in posterior view, median lobe absent (Fig. 361); S7 hemisternite narrowed apically (Fig. 437); S8 with apical process laterally flattened, ventrally projected, circular in profile (Fig. 514). Genitalia: gonostylus robust, 2.8 $\times$  longer than broad, narrow basally, curved in profile; volsella small, about one-third of gonostylar length, obliquely truncate, subrectangular in profile; penis valve with greatly elongate apex, extending anteriorly over S6 to apical brush of S4 (before dissection), dorsally projected on median margin before curving ventrally,

dorsoapical patch of hairs present, medial projection absent. *Coloration*. As in female except cream or yellow maculations as follows: outer surface of mandible, clypeus, except apical margin, inferior paraocular area, and anterior surface of scape (sometimes absent); maculations on vertex, pronotal lobe, scutum, axilla, scutellum, and femora usually reduced or absent; T1 usually with lateral spot; T2 and T3 each usually with lateral band deeply notched on posterior margin (sometimes broken); T7 with two large spots. *Pubescence*. Head and mesosoma with predominantly whitish hairs. *Sculpturing*. Terga with broader (4–5 $\times$  PW) distal margins than in female.

*Distribution*. USA: California, Oregon, and Washington, east of Cascades to south-western Montana, Wyoming, and Colorado; Rocky Mountains to the Sierra Nevada and Cascade Mountains (900–3500 m a.s.l.); absent from cismontane California. Most often recorded from Great Basin shrub steppe, Colorado Plateau shrublands, Wyoming Basin shrub steppe, Snake–Columbia shrub steppe, Wasatch and Uinta montane forests, Great Basin montane forests, Eastern Cascades forests, and Sierra Nevada forests (Fig. 579).

*Phenology*: May–September; majority of records (82%) from last half of June through first half of August.

*Floral records*: ASTERACEAE: *Macronema discoidea*. BORAGINACEAE: *Phacelia* sp. FABACEAE: *Astragalus* sp.; *Hedysarum boreale*; *Lotus argophyllus*; *Lupinus* sp.; *Medicago sativa*; *Trifolium repens*. LAMIACEAE: *Monardella linoides*; *Salvia dorrii dorrii* var. *clokeyi*. OROBANCHACEAE: *Castilleja arachnoidea*, *Castilleja flava*. RANUNCULACEAE: *Ranunculus* sp.

*Biology*: The nest architecture and other aspects of the nesting biology have been described in detail by Horning (1969) and Parker (1987) from trap nests. The main difference between these studies is the presence of resin in the nest plug in the three nests from Idaho examined by Horning (1969). Parker (1987) only found masticated plant material mixed with pebbles or other organic debris in the nests examined from Utah. Such a difference might be a misinterpretation of the nest plug origin or a variation in the materials employed, as observed in *A. maculosum*. The material used to build the nest plug in the nests of that species is variable, either consisting of packs of trichomes only, or a combined plug including trichomes followed by sections of pebbles, small pieces of wood, masticated plant material, or even pellets of lizard dung (Krombein, 1967).

*Comments:* The type of *Dianthidium balli* could not be examined.

*ANTHIDIUM FRIESEI* COCKERELL, 1911

FEMALE, FIGS 78, 158; MALE, FIGS 237, 362, 438, 515; MAP, FIG. 583

*Anthidium flavomaculatum* Friese, 1908: 70 (syn-types: whereabouts unknown; ♀, ♂, Tucuman, Mendoza, Argentina; not examined).

*Anthidium friesei* Cockerell, 1911: 181 (name replacement for *A. flavomaculatum* Friese).

*Anthidium mendocinum* Friese, 1917: 54 (name replacement for *A. flavomaculatum* Friese).

*Diagnosis:* This species is most similar to *A. danieli* (see diagnosis for that species), from which it can be easily separated by the clypeus less convex (Fig. 78), fore and mid basitarsi with outer surfaces densely covered by tomentum, and female terga shinier; the male can be separated from *A. danieli* by the terga shinier with distal margins wider (about as wide as depressed marginal zone), basitarsus of all legs yellow, and S6 with distal margin medially projected into a short, apically truncate median lobe (Fig. 362). In addition, the female of *A. friesei* has a vertex with a broad yellow band, scutum with band on anterolateral and lateral margins, and tibiae with outer surfaces yellow; in *A. danieli* such markings are reduced on the vertex and absent on the scutum and tibiae; the tibial carina is also often present in *A. friesei*, but completely absent in *A. danieli*.

*Description: Female.* Body length 11.5–13.1 mm; forewing length 8.3–9.7 mm. *Structure.* Clypeus gently convex, projected about 0.4× width of compound eye in profile, distal margin thick, gently projected sublaterally (Fig. 78); mandible with eight or nine teeth; labrum without basal protuberances, preapical projections small, nearly tuberculiform; F1 2.2× longer than broad, slightly shorter (0.9×) than combined lengths of F2 and F3. Tibial carina weak, sometimes absent. T6 gently convex basally, with small, acute lateral spine, preapical carina minutely crenulate, depressed apical rim short, projecting on slightly less than one-third of distal margin, median emargination small (Fig. 158). *Coloration.* Dark brown to black, ferruginous on scape (anterior surface sometimes yellowish), F1–F3, tegula, anterior surface of fore femur, apical two-thirds of remaining femora, fore and middle tibiae and distitarsi; yellow as follows: outer surface of mandible, clypeus, except distal margin, inferior paraocular area, broad band on vertex, pronotal lobe, tegula, except on centre, anterolateral and lateral margins of scutum with broad, continuous band, axilla, distal margin of scutellum

(narrow medially), fore femur with thin band on apical two-thirds of inferior margin, superior margins of femora with small spot apically, outer surfaces of tibiae with broad band (longer and broader on hind tibia), outer surface of hind basitarsus with diffuse band, and terga with medially interrupted bands, laterally slightly notched on posterior margin. Wings light orange basally, brownish distally; veins ferruginous basally (including stigma and prestigma), dark brown distally. *Pubescence.* Usually whitish, except light ferruginous to yellowish hairs on inner surfaces of tarsi; dark-brown to black hairs on depressed marginal zones of T1–T5 and T6 entirely (sometimes mostly light ferruginous with brownish sternal scopa). Outer surfaces of fore and middle basitarsi densely covered by tomentum (integument not visible among hairs). *Sculpturing.* Propodeal triangle shiny, finely imbricate, nearly smooth. T1–T5 with weakly elevated discal areas, smooth, shiny between punctures (2–4× PW); depressed marginal zones more densely punctate than on discs (1–2× PW); distal margins about as wide as or slightly narrower than depressed marginal zone, little differentiated from it, broadest medially, narrower on apical terga.

*Male.* Body length 13.8–16.9 mm; forewing length 10.6–10.8 mm. *Structure.* Labrum with preapical projections absent; F1 1.8× longer than broad, shorter (0.6×) than combined lengths of F2 and F3. Lateral spine of T6 gently curved, about as long as median spine of T7; lateral lobe of T7 narrow, about as wide as distance between inner margin and median spine, apex obliquely truncate, apically diverging from midline, inner margin sometimes distinctly angled, thus apex appearing arrow-shaped (Fig. 237); S4 without distinct apical brush, at most with some dense, thick hairs on median one-quarter of straight distal margin; S6, in ventral view, with basal margin straight, laterally with short, anterolaterally projected spine or angle, distal margin medially projected into short, apically truncate median lobe (Fig. 362); S7 hemisternite apically truncate (Fig. 438); S8 with narrow, short, weakly bifid, curved apical process, basally broad, about one-third width of distal margin (Fig. 515). Genitalia: gonostylus robust, about 2.0× longer than broad; volsella small, about one-third of gonostylar length, somewhat rounded in profile; penis valve about as long as gonostylus, basally rather narrow, apex pointed, blade-like, medially projecting into narrow lobe, dorsoapical patch of hairs reduced or absent, medial projection large, distinct. *Coloration.* As in female, except yellow as follows: anterior surface of scape, supraclypeus next to epistomal suture with thin transversal band (sometimes absent), basitarsi, ventrolateral surface of hind coxa with small spot (usually absent), and inferior margin

of hind femora with broad band (usually reduced or absent); maculations on vertex, scutum, axilla, and scutellum usually reduced or absent. *Sculpturing*. Terga with distal margins usually about as wide as depressed marginal zone.

*Distribution*: ARGENTINA: Catamarca, La Pampa, La Rioja, Mendoza, Neuquén, Río Negro, Salta, San Juan and Tucumán (100–3200 m a.s.l.). Recorded from the Dry Chaco, Low and High Monte, and Central Andean puna, and Patagonian and Southern Andean steppe ecosystems (Fig. 583).

*Phenology*: Mid September–February; a single record from May; the period from October through the first half of December accounts for 89% of the records.

*Floral records*: ASTERACEAE: *Baccharis* sp. ZYGOPHYLLACEAE: *Larrea divaricata*.

*Comments*: The syntypes of *A. flavomaculatum* Friese have not been examined. They are not present at the ZMB. Cockerell (1911) and Friese (1917) proposed a name replacement for *A. flavomaculatum* Friese because it was a junior homonym of the Palearctic species *Anthidium montanum* var. *flavomaculatum* Friese, 1897. Cockerell's name has priority. The name *Anthidium flavomaculatum* Cameron, 1897 is invalid (*nomen nudum*). In fact, Cameron (1897: 124) used *Anthidium flaviventre* for an Oriental species now placed in the genus *Pseudoanthidium* Friese, 1898. The error was created by Colonel C.T. Bingham in a monograph of the Indian Hymenoptera published in the same year (Bingham, 1897: 492).

#### ANTHIDIUM FUNEREUM SCHLETTERER, 1890

FEMALE, FIGS 79, 159; MALE, FIGS 238, 363, 439, 516; MAP, FIG. 583

*Anthidium funereum* Schletterer, 1890: 231 (holotype: NHMW; ♂, Chile).

*Anthidium melanotrichum* Friese, 1904b: 303 (holotype: NHMW; ♀, Valparaíso, Chile); Urban, 2002: 508 (synonymy with *funereum*).

*Anthidium garleppi* Schrottky, 1910: 267 (lectotype: MZUSP; ♀, Apurímac, Peru); Urban, 2001a: 266 (type designation) (**new synonym**).

*Anthidium matucanense* Cockerell, 1914: 314 (holotype: AMNH; ♂, Matucana, Lima, Peru); Urban, 2002: 508 (synonymy with *garleppi*).

*Anthidium melanotrichum griseopilosum* Friese, 1920: 54 (lectotype: ZMB; ♂, Cuenca, Azuay, Ecuador); Urban, 2002: 508 (synonymy with *garleppi*) (**new lectotype designation**).

*Anthidium bombiforme* Friese, 1920: 55 (lectotype: ZMB; ♂, Santiago, Chile); Urban, 2002: 508 (synonymy with *funereum*) (**new lectotype designation**).

*Anthidium aterrimum* Friese, 1925: 39 (holotype: ZMB; ♀, Antofagasta, Chile; not examined); Urban, 2002: 508 (synonymy with *funereum*).

*Anthidium piliventre* Friese, 1925: 40 (Syntypes: ZMB; ♂ ♀, Arequipa, Peru); Friese 1930: 127 (junior primary homonym of *A. piliventre* Friese, 1913).

*Anthidium atricaudum* Cockerell, 1926a: 218 (holotype: USNM 58052; ♀, Arequipa, Yura, Peru) (**new synonym**).

*Anthidium ruizi* Reed, 1930: 375 (lectotype: CAS 18498; ♂, Cordillera de Santiago, Chile); Urban, 2002: 508 (synonymy with *funereum*) (**new lectotype designation**).

*Diagnosis*: This species is highly variable in the colour of the pubescence and integument (see description and comments below). It resembles *A. peruvianum*, *A. spatulatum* sp. nov., and *A. toro* in the shape of T6 (Fig. 79), F1 elongate, female labrum with strong basal protuberances (as in Fig. 11), and in the shapes of male T7 (Fig. 238) and S6 (Fig. 363). In addition to the larger body size and denser pubescence of both sexes, the female can be separated from those species by the sternal scopa black, and the male by the T6 and T7 more densely punctate, S7 hemisternite with pointed apex (Fig. 439), and S8 with longer and stouter apical process (Fig. 516).

*Description*: *Female*. Body length 10–12 mm; forewing length 8.9–9.3 mm. *Structure*. Clypeus weakly convex, projected about 0.4× width of compound eye, distal margin thin, variable, straight or nearly straight, wavy or gently tuberculate (Fig. 79); mandible with six teeth; labrum with strong basal protuberances (sometimes low), visible even when mandibles closed, separated by about two times width of protuberance, preapical projections absent; F1 elongate, 2.3× longer than broad, about as long as combined lengths of F2 and F3. Tibial carina absent. T6 nearly straight in profile, gently convex basally, distal margin crenulate, straight or nearly straight between lateral and submedian spines, slightly longer (~1.3×) than distance between submedian spines (Fig. 159). *Coloration*. Black, except brownish on apical flagellomeres, outer surfaces of mandible and distitarsi; yellow or cream as follows: oval to rounded spot laterally on vertex, T1 with medially interrupted band, laterally deeply notched on posterior margin, T2–T5 each with four spots, and T6 with two large spots (sometimes reduced or absent). Wings hyaline, slightly brownish; veins and stigma dark brown. *Pubescence*. Highly variable in colour, ranging from entirely dark brown or black to largely whitish,



with dark hairs on vertex, dorsum of mesosoma (intermingled with whitish hairs), inner surfaces of tarsi, depressed marginal zones of T3 and T4, entire surface of remaining terga, and sternal scopa. Fore basitarsus with sparse fringe of long hairs ( $\geq 2\times$  basitarsal width) along posterior margin. *Sculpturing*. Propodeal triangle dull, finely punctate. T1–T5 with weakly elevated discal areas, shiny, finely lineolate between punctures ( $1\text{--}3\times$  PW); depressed marginal zones about as densely punctate as on discs, sparsely punctate medially on T3–T5; distal margins smooth, shiny (sometimes dull or weakly shiny, finely lineolate), about one-third of depressed marginal zone.

*Male*. Body length 10.3–13.1 mm; forewing length 8.5–11.1 mm. *Structure*. Labrum without basal protuberances; F1  $2.2\times$  longer than broad, slightly shorter ( $0.8\times$ ) than combined lengths of F2 and F3. Lateral spine of T6 gently curved, about as long as median spine of T7; lateral lobe of T7 about as wide as, or slightly broader than, distance between inner margin and median spine, apically narrow and curved, outer margin nearly straight, inner margin curved (Fig. 238); S4 without apical brush, distal margin straight; S6, in ventral view, with straight basal margin, laterally with short, blunt, ventrolaterally directed spine, with broad median emargination ( $\sim 5.0\times$  broader than deep) on about  $0.4\times$  distal margin (Fig. 363); S7 hemisternite apically pointed (Fig. 439); S8 with rather long, stout, ventrally bent ( $\sim 70^\circ$ ), simple apical process, basally broad, about one-third width of distal margin (Fig. 516). Genitalia: gonostylus robust, about  $3.0\times$  longer than broad; volsella small, about one-sixth of gonostylar length, subrectangular in profile; penis valve slightly shorter than gonostylus, rather narrow, apically pointed, blade-like, dorsally projecting into large lobe at same level of large medial projection, dorsoapical patch of hairs absent. *Coloration*. As in female, except yellow or cream on outer surface of mandible, clypeus, except distal margin, inferior paraocular area, and outer surface of hind basitarsus (usually absent). *Pubescence*. Highly variable, as in female, ranging from entirely dark brown or black with whitish hairs on face, dorsum of mesosoma, pronotal lobe, ventral surface of mesepisternum, and outer surfaces of fore tarsi, to largely whitish with dark hairs on vertex, dorsum of mesosoma (intermingled with whitish hairs), tibiae, femora, depressed marginal zones of T3 and T4, entire surface of remaining terga, and sterna.

*Distribution*. ARGENTINA, BOLIVIA, CHILE, PERU, and ECUADOR: mid to high elevations along the Andes (1500–4200 m a.s.l.). Primarily found in arid and semi-arid regions. Recorded from Sechura and

Atacama deserts, Low Monte, Central Andean puna, wet puna, and dry puna, Bolivian montane dry forests, Eastern Cordillera real montane forests, Patagonian steppe, and Peruvian Yungas, with the majority of records from Sechura Desert and Central Andean dry puna ecoregions (Fig. 583).

*Phenology*. Recorded in every month of the year; July and December account for 26 and 22% of records, respectively.

*Comments*. The long list of synonymies of this species is a consequence of its great morphological variation. Both sexes vary in body size, yellow markings on terga, and colour and length of body pubescence. Unlike specimens from Chile, both sexes from Ecuador to Bolivia tend to be more slender and to have more developed yellow spots on the terga, and whitish pubescence on the head, mesosoma, and the basal terga. Chilean specimens have reduced yellow spots on the terga, nearly absent in some specimens, and largely black pubescence on the body (except for whitish or grey hairs on the vertex and scutum in some specimens); the body pubescence is somewhat denser and longer in specimens from Chile, presenting a more robust and *Bombus*-like appearance than specimens from other localities. Also, in females from Ecuador to Bolivia the clypeal margin tends to be more sinuous (tuberculate in one specimen from Peru), and the basal labral tubercles are stronger than those from Chile. Despite these variations, we did not find consistent differences in the shape of T6 of the female, and T7, S6–S8, and genitalia of the male that reliably separate these forms. It might be possible that those pale pubescent, extensively yellow-coloured forms separated as *A. atricaudum* and *A. garleppi sensu* Urban (2002) represent the same species, distinct from the largely black *A. funereum* from Chile. However, given that we did not find distinct differences in those structures that have proved to be reliable in separating other species of *Anthidium*, namely T6 of female, and T7, S6–S8, and genitalia of male, we have decided not to recognize *A. atricaudum* and *A. garleppi sensu* Urban (2002): such names are synonymized under *A. funereum*, the oldest name of the three.

The male holotype of *A. funereum*, as indicated in Schletterer's original description, is in Vienna (NHMW). The label data for this specimen are: 'Philipi Chili 1870 // *funereum* Type det. Schletterer // Lectotype *funereum* Schletterer J.S. Moure 1958'. The museum also has a female with the same data as the holotype, including Schletterer's original type label. Perhaps because of the type label on the female specimen, J.S. Moure apparently thought of these two specimens as syntypes and added a lectotype label to

the male; Moure did not formalize this designation in any publication. However, the male specimen is the unique type because the female is not mentioned in Schletterer's original description. There is also no mention of other male specimens in the original description. To avoid further confusion, we added a red label with the following note to the type: 'This is the true type as indicated in Schletterer's (1890) original description. V.H. Gonzalez & T. Griswold 2010'.

To stabilize the names, the following lectotypes are designated because a holotype was not designated in the original description.

*Anthidium melanotrichum griseopilosum* Friese, 1920. Although this species was described from both sexes, a male specimen deposited in ZMB bears Friese's red type label. The label data for this specimen, herein designated as the lectotype, are as follows: 'Ecuador Cuenca (handwritten) 1901 2200 mts (handwritten) // ♂ *Anthi. melanotrichum griseopilosum* 1910 Friese det. // Type (on red label) // Zool. Mus. Berlin (yellow label) // (red label) ♂ Lectotype *Anthidium melanotrichum griseopilosum* Friese Des. V.H. Gonzalez & T. Griswold 2009'.

*Anthidium bombiforme* Friese, 1920. Likewise, a red 'type' labelled male specimen of *A. bombiforme* is herein designated as the lectotype. The label data for this specimen are as follows: 'Chile, Santiago, 1890, Philippi // *Anthidium bombiforme* ♂ 1915 Friese det. // Type (red label) // Zool. Mus. Berlin // Lectotype *Anthidium bombiforme* Friese ♂ Des. V.H. Gonzalez & T. Griswold 2009'.

*Anthidium ruizi* Reed, 1930. This species was also described from both sexes. The original description includes a photograph of a male and a female specimen (Reed, 1930: fig. 76), which accurately match two specimens from the Reed Collection deposited in CAS. This collection, according to the curator Mr Vincent Lee, also includes some specimens from the Herbst Collection, and was purchased by E.S. Ross in the mid-1950s. These two specimens have the general 'CHILE/DR. REED/19 (either 20 (?) or 30)' label, with an illegible locality, the distinctive 'DR. REED VALPARAISO' label, and 'E.P. Reed Collection' label, probably added to the specimens by CAS personnel. The male specimen also has a determination label by Moure and an apparently original determination label by Reed. The other five specimens of *A. ruizi* in the Reed Collection (three males and two females) were apparently collected in 1934 (illegibly handwritten). We chose as the lectotype the male that matches the photograph in the original description and bears the presumably original determination label written by Reed. The label data for the lectotype specimen are as follows: 'CHILE DR. REED (illegible locality) 19(20 or 30) // DR. REED VALPARAISO // E.P. Reed Collection // ♀ *A. ruizi* Reed // ♂ *Anthidium ruizi* Reed

Det. J.S. Moure 1957 // Lectotype *Anthidium ruizi* Reed Des. V.H. Gonzalez & T. Griswold 2009'. We added a yellow paralectotype label to the female with same data as the lectotype.

The type of *A. aterrimum* could not be examined.

#### ANTHIDIUM GAYI SPINOLA, 1851

FEMALE, FIGS 80, 160; MALE, FIGS 239, 304, 364, 440, 517; MAP, FIG. 583

*Anthidium gayi* Spinola, 1851: 180 (syntypes: MSNT; ♀, ♂, Coquimbo, Chile; not examined).

*Anthidium coloratum* Smith, 1854: 211; Herbst, 1907: 131 (synonymy with *gayi*) (lectotype: BMNH 17A.2665: ♂, Chile) (**new lectotype designation**).

*Anthidium spinolae* Gribodo, 1894: 204 (holotype: whereabouts unknown; ♂, Parral, Chile; not examined); Herbst, 1921: 104 (synonymy with *gayi*).

**Diagnosis:** The female of this species is most similar to that of *A. colliguayanum* in the following combination of characters: small body size (8–11 mm); clypeus black, weakly convex, covered with normal hairs, with distal margin distinctly thickened, often tuberculate (Fig. 80); and T6 with small but distinct lateral spine (Fig. 160); however, the outer surfaces of basitarsi are not covered with dense tomentum, and the depressed apical rim of T6 is broad and rounded, not sinuous as in *A. colliguayanum* (Fig. 145). The male can be recognized by its small body size, T7 with lateral lobe acutely triangular (Fig. 239), and S6 with lateral angle small, sharp, and distal margin gently sinuous, nearly straight (Fig. 364).

**Description:** *Female.* Body length 8.4–9.5 mm; forewing length 6.6–7.2 mm. **Structure.** Clypeus weakly convex, projected about 0.3× width of compound eye, distal margin distinctly thick, usually tuberculate (Fig. 80); mandible with six or seven teeth; labrum without basal protuberances, preapical projections small but distinct; F1 1.7× longer than broad, slightly shorter (0.9×) than combined lengths of F2 and F3. Tibial carina absent. T6 nearly straight in profile, gently convex basally, with small, acute lateral spine, depressed apical rim distinct, rounded, projecting on one-quarter of distal margin (Fig. 160). **Coloration.** Black, except ferruginous on antenna, pronotal lobe, tegula, and legs, excluding coxae, trochanters, and base of femora; cream or yellow as follows: oval spot laterally on vertex (sometimes with submedian thin bands connecting oval spots) and T1–T5 with medially interrupted bands, closer on apical terga. Wings light orange basally, brownish distally; veins ferruginous basally (including stigma and prestigma), dark brown distally. **Pubescence.** Whitish, except yellowish to ferruginous hairs on scape, face, vertex, pronotal

lobe, dorsum of mesosoma, and ferruginous areas of legs; dark brown to black hairs on depressed marginal zones of T1–T3, entire surface of remaining terga, and S2–S5. Fore basitarsus with sparse fringe of long hairs ( $\geq 2\times$  basitarsal width) along posterior margin. *Sculpturing*. Propodeal triangle weakly shiny, finely lineolate to imbricate. T1–T5 with weakly elevated discal areas, dull or weakly shiny, finely lineolate between sparse punctures ( $2-4\times$  PW); depressed marginal zones more densely punctate than on discs ( $1-2\times$  PW); distal margin dull, about one-third of depressed marginal zone, narrowest on T5.

*Male*. Body length 8.9–10.0 mm; forewing length  $\sim 7.2$  mm. *Structure*. Labrum without preapical projections; F1  $1.6\times$  longer than broad, shorter ( $0.7\times$ ) than combined lengths of F2 and F3; lateral spine of T6 straight or nearly straight, about as long as median spine of T7; lateral lobe of T7 acutely triangular, about as long as median spine (Fig. 239); S4 with apical brush of long, dark reddish brown hairs on median one-fifth of straight distal margin (Fig. 304); S6, in ventral view, with gently convex to nearly straight basal margin, laterally with small, sharp, ventrally directed angle, distal margin gently sinuous to nearly straight (Fig. 364); S7 hemisternite as in Figure 440; S8 with short, curved, simple apical process, basally broad, about one-third width of distal margin (Fig. 517). Genitalia: gonostylus about  $3.0\times$  longer than broad; volsella large, about half of gonostylar length, apically narrowed, digitiform, ventrally curved; penis valve about as long as gonostylus, long, narrow, apically pointed, blade-like, dorsoapical patch of hairs absent, medial projection large, distinct. *Coloration*. As in female, except yellow on outer surface of mandible, clypeus, except distal margin, inferior paraocular area, and basitarsi. *Pubescence*. Clypeus, supraclypeus, paraocular area, and inferior surface of fore femur with whitish hairs. *Sculpturing*. Terga with broader distal margins than in female, about half width of depressed marginal zone.

*Distribution*. ARGENTINA: Chubut, Neuquén, Río Negro, Santa Cruz. CHILE: Coquimbo to Aisén (100–3300 m a.s.l.). Recorded from Valdivian temperate forests, Chilean matorral, Southern Andean, and Patagonian steppe ecoregions, with the vast majority of records from the Valdivian temperate forests (Fig. 583).

*Phenology*: Recorded from every month except April and August; most records (89%) from December through first half of February.

*Floral records*: FABACEAE: *Trifolium repens*. NOTHOFAGACEAE: *Nothofagus* sp.

*Comments*: In some specimens the pubescence of head and mesosoma, excluding the inner surfaces of the tarsi, is entirely pale.

*Anthidium coloratum* Smith, 1854, was described from both sexes but the holotype was not designated in the original description. To stabilize the name, we herein designate a male specimen as the lectotype, given the distinctive characters of this sex. The label data for this specimen are as follows: 'Chile // Syntype // B.M. TYPE HYM. 17a.26656 // = *Anthidium gayi* Spinola 1851. Det. A.R. Moldenke '78 // (red label) ♂ Lectotype *Anthidium coloratum* Smith Des. V.H. Gonzalez & T. Griswold 2010'. The types of *A. gayi* and *A. spinolae* could not be examined.

#### ANTHIDIUM HALLINANI SCHWARZ, 1933

FEMALE, FIGS 26, 81, 161; MALE, FIGS 240, 305, 365, 441, 518; MAP, FIG. 577

*Anthidium hallinani* Schwarz, 1933: 4 (holotype: AMNH; ♂, Canal Zone, Panama).

*Diagnosis*: This species is most similar to *A. aztecum* in the overall shape of T6 of the female and T7, genitalia, and associated sterna of the male; however, in the female of *A. hallinani* the depressed apical rim of T6 is only visible medially, with the median emargination continuing basally into a short carina (Fig. 161), whereas in *A. aztecum* it is visible across almost its entire width and lacks the short carina above the median emargination (Fig. 136). In the male, S4 is more distinctly emarginate medially, with the apical brush denser and slightly broader ( $\sim 0.4\times$  sternal width) than in *A. aztecum* (compare Figs 287 and 305); S6 is not as sharply projected laterally and the distal margin is more distinctly truncate than in *A. aztecum* (Figs 340 and 365); the apical process of S8 is broader basally than in *A. aztecum*, projecting on median half of distal margin (Figs 493 and 518). Also, both sexes of *A. hallinani* have the tegula and legs ferruginous, with more extensive yellow markings on the mesosoma than in *A. aztecum*.

*Description*: *Female*. Body length 9.2–11.2 mm; forewing length 6.8–8.0 mm. *Structure*. Clypeus prominently convex, projected about  $0.4\times$  width of compound eye, distal margin straight or nearly straight, two lateralmost tubercles usually more distinctly projected (Fig. 81); mandible with seven teeth; labrum without distinct basal protuberances, preapical projections large, distinctly curved upwards; F1  $1.7\times$  longer than broad, slightly shorter ( $0.8\times$ ) than combined lengths of F2 and F3. Tibial carina present. T6 nearly straight in profile, disc gently flattened, somewhat truncate distally, depressed apical rim ending about half distance between median



emargination and lateral angle, median emargination continuing basally into short carina (Fig. 161). *Coloration*. Predominantly dark brown to black, except light-reddish brown on anterior surface of antennal flagellum, tegula, distal half of femora, inner surfaces of tibiae and tarsi, and sterna; yellow as follows: outer surface of mandible, distal half of clypeus, except medially (sometimes broadly interrupted), inferior paraocular area, anterior surface of scape (sometimes reduced or absent), broad band on vertex (usually narrowed or interrupted medially), pronotal lobe, anterolateral and lateral margins of scutum with continuous broad band, axilla, distal margin of scutellum, inferior margins of fore and mid femora, outer surfaces of tibiae, T1–T5 with complete bands (sometimes medially interrupted on T1), and T6 with large, median rectangular spot. Wings hyaline, slightly brownish; veins and stigma dark brown. *Pubescence*. Whitish, except brownish to light ferruginous hairs on vertex, pronotal lobe, mesepisternum and metepisternum dorsally, sides of propodeum, scutum, axilla, scutellum, inner surfaces of tarsi, and S6. Outer surfaces of basitarsi densely covered by tomentum (integument not visible between hairs). *Sculpturing*. Propodeal triangle finely lineolate, dull. T1–T5 with weakly elevated discal areas, dull, weakly imbricate between dense ( $1\text{--}2\times$  PW) punctures (larger punctures slightly larger than those on depressed marginal zone); depressed marginal zones slightly more densely punctate than discs ( $\leq 1\times$  PW); distal margins dull, narrow ( $2\text{--}3\times$  PW; Fig. 26).

*Male*. Body length 10.3–14.6 mm; forewing length 7.7–8.9 mm. *Structure*. F1  $1.6\times$  longer than broad, shorter ( $0.8\times$ ) than combined lengths of F2 and F3. Lateral spine of T6 straight or nearly straight, about as long as median spine of T7; lateral lobe of T7 broadly rounded, about  $3.0\times$  distance between inner margin and median spine (Fig. 240); S4 with broad ( $\sim 0.4\times$  sternal length), dense, reddish brown brush of short hairs on gently emarginate distal margin (Fig. 305); S6, in ventral view, with gently convex basal margin, lateral projection sharp, ventrolaterally directed, distal margin thickened, narrowly truncate medially, straight in posterior view (Fig. 365); S7 hemisternite rounded distally (Fig. 441); S8 with apical process straight in profile, weakly bifid apically, basally about half width of distal margin (Fig. 518). Genitalia: gonostylus slender, about  $6.0\times$  longer than broad; volsella apically rounded, elongate, about two-thirds of gonostylar length, ventroapically projected, not partially covering penis valves, dorsally with small basal projection; penis valve about as long as gonostylus, apex medially directed, blade-like, dorsoapical patch of hairs reduced or absent, medial projection large, distinct, heavily sclerotized with three distinct ridges (dorsal ridge sometimes appear-

ing as a separated lobe). *Coloration*. As in female, except: clypeus dark brown to black on basal third, sometimes also along midline; tarsi yellow; T6 with large, median rectangular spot; T7 usually ferruginous.

*Distribution*. Southern MEXICO: Chiapas. COSTA RICA, PANAMA (0–1100 m a.s.l.). Recorded from Chiapas Depression, Central American and Panamanian dry forests, Central American pine–oak forests, Costa Rican seasonal, Isthmian–Atlantic, and Sierra Madre de Chiapas moist forest ecoregions; 96% of records are from dry forest (Fig. 577).

*Phenology*: November–March, single record from September; majority of records (51%) from last half of January and first half of February.

*Floral records*: FABACEAE: *Stylosanthes guianensis*. LAMIACEAE: *Hyptis* sp.

#### ANTHIDIUM IGORI URBAN, 2001

MALE, FIGS 241, 366, 442, 519

*Anthidium igori* Urban, 2001b: 542 (holotype: DZUP; ♂, Canta, Lima, Peru).

*Diagnosis*: This species is known only from the male (but see comments below), which can be easily recognized by S4 without an apical hair brush, T7 with lateral lobe digitiform (Fig. 241), and shape of S6 (Fig. 366) and S8 (Fig. 519).

*Description*: *Male*. Body length 10.8 mm. *Structure*. F1  $1.7\times$  longer than broad, shorter ( $0.8\times$ ) than combined lengths of F2 and F3; tibial carina weakly indicated, nearly absent; lateral spine of T6 straight or nearly straight, about as long as median spine of T7; lateral lobe of T7 tapering distally, spiniform, basally slightly wider than distance between inner margin and median spine, outer margin straight (Fig. 241); S4 with distal margin gently concave, apical hair brush absent; S6, in ventral view, with gently convex basal margin, laterally with blunt, posteriorly directed spine, as seen in profile, distal margin gently convex, with small median projection (Fig. 366); S7 hemisternite somewhat apically truncate (Fig. 442); S8 with apicolateral margins strongly bent dorsally, lateral margins thus gently converging towards apex in ventral view, apical process weakly bifid (Fig. 519). Genitalia: gonostylus robust, apically curved in ventral view, broader at apex in profile; volsella small, less than one-third of gonostylar length, subtriangular in ventral view; penis valve about as long as gonostylus, laterally compressed, apically curved, medial projection small. *Coloration*.

Dark brown to black, except: ferruginous on legs (excluding fore coxa to femur); yellow on clypeus, except distal margin, inferior paraocular area, vertex with rounded to oval spot behind compound eye, and terga with medially interrupted bands, laterally deeply notched on anterior margin, except T1 and T2, each with four spots, and T6, with two large submedian spots; basitarsi slightly yellowish. Wings hyaline, slightly brownish; veins and stigma mostly dark brown. *Pubescence*. Whitish, except light ferruginous hairs on inner surfaces of tarsi. *Sculpturing*. Propodeal triangle weakly shiny, weakly lineolate to imbricate. T1–T5 with weakly elevated discal areas, dull to weakly shiny, weakly lineolate to imbricate between punctures (2–3× PW); depressed marginal zones with slightly denser punctures than on discs (1–2× PW); distal margins dull, broad, about one-third width of depressed marginal zone.

*Distribution*. PERU: Ancash, La Libertad, Lima (2800–3200 m a.s.l.). Recorded from the Sechura desert ecoregion.

*Phenology*: May.

*Comments*: Urban (2001b) described *A. igori* from a single male from Canta, Peru. She later described the female based on a specimen from Huaylas (Departamento of Ancash), a locality about 300 km north of Canta (Urban, 2002). This female seems to be conspecific with *A. tarsoi*, another species from Canta known from the female holotype. Except for the terga being slightly duller with four yellow spots on T1–T5 (medially interrupted bands in *A. tarsoi*), we did not find significant morphological differences between these specimens. Similar differences were also noted in two females from La Libertad, Peru.

We were inclined to render *A. tarsoi* as a subjective junior synonym of *A. igori*, but declined to take such an action given that *A. rozeni*, a presumably related species, is also known from the male holotype collected in Canta (see comments for that species). The sex association of these species needs to be clarified.

#### *ANTHIDIUM ILLUSTRE* CRESSON, 1879

FEMALE, FIGS 82, 162; MALE, FIGS 38, 242, 306, 367, 443, 520; MAP, FIG. 579

*Anthidium illustre* Cresson, 1879: 206 (lectotype: ANSP 2399; ♀, Nevada, USA); Cresson, 1916: 120 (lectotype designation).

*Anthidium serranum* Cockerell, 1904a: 24 (holotype: BMNH 17a.2690, ♂, Rock Creek, California, USA); Schwarz, 1940: 3 (synonymy with *illustre*).

*Callanthidium illustre*; Michener, 1951: 1143; Grigarick & Stange, 1968: 36; Hurd, 1979: 1992.

*Anthidium (Callanthidium) illustre*: Griswold & Michener, 1988: 29–30.

*Diagnosis*: The female of this species can be separated from all other North American *Anthidium* except *A. formosum* by the combination of a large body size (length > 11 mm), body heavily maculated, and T6 with deep median emargination on distal margin (Fig. 157). From *A. formosum* it can be differentiated by T6 with semicircular emargination and labrum with preapical projections. The male shares with *A. formosum* the greatly elongate penis valves, a trait not found in other North American *Anthidium*. It is easily distinguished from *A. formosum* by the following characters: hind coxa ventrally flattened, with modified pubescence (Fig. 38); T7 with median spine short, blunt (Fig. 242); S4 with apical brush weak (Fig. 306); and S6 with a medial spine on distal margin (Fig. 367). Both sexes also have more extensive yellow markings than in *A. formosum*, as indicated in the diagnosis of that species.

*Description*: *Female*. Body length 11.5–16.5 mm; forewing length 9.2–11.5 mm. *Structure*. Clypeus prominently convex, projected about 0.5× width of compound eye in profile, distal margin thin, gently concave to nearly straight (Fig. 82); mandible with six, seven, or eight teeth; labrum without basal protuberances, preapical projections large, distinctly curved upwards; F1 1.9× longer than broad, slightly shorter (~0.8×) than combined lengths of F2 and F3. Tibial carina absent. T6 gently convex basally, not distinctly elevated along midline, with small, distinct lateral spine, preapical carina absent, depressed apical rim absent, distal margin with deep emargination (Fig. 162). *Coloration*. Dark brown to black, except yellow as follows: outer surface of mandible, clypeus, except along midline, paraocular area (band above antennal socket, broader than in *A. formosum*, ending just below level of lateral ocellus), outer surface of scape (usually absent or reduced), gena, broad band on vertex continuing to gena, pronotal lobe, anterior half of tegula (usually also on outer margin), costal sclerite (usually absent), anterolateral and lateral margins of scutum, disc of scutum sometimes with thin (2–3× PW), short (1.0–1.3× tegula length) band on each side of midline, axilla, distal half of scutellum, except medially, upper half of mesepisternum, lower half of metepisternum (usually reduced or absent), hind coxa and trochanter (sometimes reduced or absent), femora, except anterior and superior surfaces of fore and middle femora, and posterior surface of hind femur, outer surfaces of tibiae and basitarsi, T1–T5 with medially interrupted

bands (weakly interrupted to nearly entire on T5, usually notched on posterior margin on T1), T6 entirely, except distal margin and two sublateral spots, and discs of S2–S6 except sublateral oval spots on S2–S4 (sometimes also on S5 and centre of S6); distitarsi yellowish or brownish. Wings hyaline, slightly ferruginous, particularly on basal half; veins and stigma dark brown. *Pubescence*. Yellowish to light ferruginous (sometimes whitish hairs on sides of mesosoma, legs, excluding tarsi and metasoma). Clypeus with some erect, simple, apically wavy hairs on disc. *Sculpturing*. Propodeal triangle shiny, finely imbricate–lineolate. T1–T5 with weakly elevated discal areas, weakly shiny; depressed marginal zones dull, more coarsely, densely punctate ( $\leq 1$  PW) than on discs; distal margins narrow ( $2\text{--}3\times$  PW).

*Male*. Body length 14.6–18.5 mm; forewing length 10.8–13.1 mm. *Structure*. F1  $1.7\times$  longer than broad, shorter ( $0.7\times$ ) than combined lengths of F2 and F3. Hind coxa ventrally flattened. Lateral spine of T6 straight or nearly straight, much longer than blunt median spine of T7; lateral lobe of T7 usually curved, outer and inner margins gently convex to nearly straight, thus lobe appearing sometimes broadly subtriangular (Fig. 242); S3 as in S4, shallowly emarginated on median one-third of distal margin, without distinct apical brush, except tuft of thick, reddish brown hairs on sides of emargination (Fig. 306); S6, in ventral view, weakly biconvex on basal margin, lateral lobe obliquely truncate, median lobe small, triangular (Fig. 367); S7 with somewhat pointed distal margin (Fig. 443); S8 with pointed distal margin in ventral view, apex laterally flattened, dorsally projected, semicircular in profile view (Fig. 520). Genitalia: gonostylus robust,  $3.5\times$  longer than broad, narrowed basally, curved in profile, with somewhat pointed apex in ventral view; volsella small, about one-third of gonostylar length, obliquely truncate, subrectangular in profile; penis valve with greatly elongate apex, extending anteriorly over S6 to apical brush of S4 (Fig. 38) (before dissection), dorsally projected on median margin before bending ventrally, dorsoapical brush of hairs present, medial projection small, weakly sclerotized. *Coloration*. As in female, except yellow as follows: gena and vertex with continuous broad band (sometimes medially interrupted), outer surface of F1 sometimes with small spot, T1–T6 with medially interrupted bands (weakly interrupted to nearly entire T6, usually notched on posterior margin on T1–T3), T7 entirely, except lateral and distal margins, midline, and two sublateral dark spots, and sides of S2–S5 usually with diffuse spots; maculations usually reduced or absent on paraocular area (band not continuing above antennal sockets), outer surface of scape, disc of scutum, upper half of mesepisternum, and metepisternum. *Pubescence*.

Hind coxa with flattened ventral surface densely covered with short, stout, simple, dark-brown hairs. *Sculpturing*. Terga with depressed marginal zones slightly sparser than in female.

*Distribution*. USA: California, southern Oregon to south-western Utah, New Mexico. Adjacent MEXICO: Baja California (0–2700 m a.s.l.). Particularly abundant in Mediterranean scrub habitats; absent from most xeric ecoregions (Fig. 579).

*Phenology*. Late February–August, two records from mid October; May through July account for 94% of records.

*Floral records*. ASTERACEAE: *Antennaria* sp.; *Artemisia californica*; *Cirsium* sp.; *Helianthus* sp. BORAGINACEAE: *Cryptantha intermedia*; *Eriodictyon crassifolium*, *Eriodictyon tomentosum*, *Eriodictyon trichocalyx* var. *lanatum*; *Phacelia brachyloba*, *Phacelia distans*, *Phacelia grandiflora*, *Phacelia heterophylla virgata*, *Phacelia imbricata*, *Phacelia malvifolia*, *Phacelia ramosissima*; *Turricula parryi*. FABACEAE: *Astragalus douglasii*; *Dalea searlsiae*; *Lathyrus odoratus*; *Lotus argophyllus*, *Lotus glaber*, *Lotus oblongifolius*, *Lotus scoparius*,\* *Lupinus albi-frons*; *Medicago sativa*; *Robinia neomexicana*. FUMARIACEAE: *Dicentra chrysantha*. LAMIACEAE: *Lepechinia calycina*. LILIACEAE: *Calochortus* sp. MALVACEAE: *Malacothamnus aboriginum*, *Malacothamnus fasciculatus*; *Sphaeralcea ambigua*. ONAGRACEAE: *Clarkia cylindrica*. OROBANCHACEAE: *Castilleja plagiotoma*; *Cordylanthus nevinii*. PLANTAGINACEAE: *Antirrhinum multiflorum*; *Collinsia* sp.; *Penstemon palmeri*. POLEMONIACEAE: *Gilia* sp. POLYGONACEAE: *Eriogonum* sp. THEMIDACEAE: *Triteleia lugens*.

*Biology*. Nests have been found in the ground, inside tunnels of abandoned nests of *Anthophora occidentalis* Cresson, 1869 (Apidae) (Johnson, 1904), inside burrows made by coleopterans within old, dead flower stalks of *Hesperoyucca whipplei* (Agavaceae) (Hicks, 1929b), and in trap nests (Parker, 1987). According to Hicks (1929b), females collected trichomes from *Lepidospartum squamatum* (Asteraceae) and males seemed to have a territorial behaviour similar to that reported for other species of *Anthidium* (e.g. *A. banningense* and *A. manicatum*). In addition to the associated organisms reported by these three authors (Table 1), Hurd (1979) also listed *Nemognatha scutellaris* LeConte, 1853 (Coleoptera: Meloidae) and *Sphaerophthalma unicolor* (Cresson, 1865) (Hymenoptera: Mutillidae) as parasites of *A. illustre*.



*Comments:* Similar modifications in the hind coxa of the male (i.e. flattened ventral surface densely covered with short, stout, simple, dark-brown hairs) are also present in *A. chamelense*, *A. latum*, and *A. rodriguezi*.

***ANTHIDIUM INSIGNISSIMUM* STRAND,  
1910 STAT. NOV.**

FEMALE, FIGS 83, 163; MALE, FIGS 37, 368, 444, 521  
*Anthidium insignissimum* Strand, 1910: 544 (lecto-  
type: ZMB; ♂, Villa Morra, Asunción, Paraguay)  
(**new lectotype designation**).

*Diagnosis:* Both sexes of this species have hind tibial carina and preoccipital border sharp. In addition, the female can be distinguished from most South American *Anthidium* by the clypeus without modified hairs and distal margin entirely tuberculate, and T6 with depressed apical rim not projecting laterally as a lobe. An additional character that distinguishes the male of this species from all other South American species except *A. latum* and *A. meloi* sp. nov. is the distinctive structure of T7 composed of spinose submedial and lateral projections, with the submedial spines shorter than the lateral spines. *Anthidium insignissimum* is most similar to *A. meloi* sp. nov., from which it can easily be separated by T6 of the female, which lacks a distinct lateral spine (Fig. 163), and by the very narrow distal margins of the terga ( $\leq 1 \times$  PW). The male can be separated from *A. meloi* sp. nov. by the lateral spine of T6 stout and somewhat blunt, T7 with lateral lobe stouter and without a median spine (Fig. 37), and genitalia with the bridge of the penis valves broader laterally, and with shorter and more pointed lateral projections. In addition, the ventral surface of the mesepisternum is sparsely papillate in *A. insignissimum*, whereas it is densely covered by short, stout, simple, ferruginous to dark-brown hairs in *A. meloi* sp. nov.

*Description: Female.* Body length 11.5 mm; forewing length 8.2–8.5 mm. *Structure.* Clypeus prominently convex, projected about  $0.4 \times$  width of compound eye in profile, distal margin swollen (not distinctly depressed above margin), strongly tuberculate (Fig. 83); mandible with five teeth; labrum without basal and preapical protuberances or projections; F1  $1.7 \times$  longer than broad, slightly shorter ( $0.8 \times$ ) than combined lengths of F2 and F3; preoccipital border sharp, not distinctly carinate. Tibial carina present. T6 gently convex in profile, weakly elevated along midline, without distinct lateral spine (sometimes angled), preapical carina present across gently convex distal margin, depressed apical rim projecting on entire distal margin, but only visible medially in dorsal view (Fig. 163); S6 laterally projected, gently

surpassing distal margin of T7 in dorsal view (often obscured by hairs). *Coloration.* Black, except ferruginous on F1–F3, tegula (sometimes darkened), legs, excluding coxae and bases of trochanters (sometimes outer surfaces of hind tibia and basitarsus), and sterna; yellow as follows: outer surface of mandible, clypeus, except large U-shaped black spot basally, inferior paraocular area, anterior surface of scape (sometimes absent), band on vertex and upper portion of gena, pronotal lobe, margins of tegula, anterolateral and lateral margins of scutum with continuous broad band, axilla, distal margin of scutellum, sides of middle and hind coxae with small spot, inferior margin of middle femur with thin band distally, superior surfaces of femora with small spot apically (sometimes absent), outer surfaces of tibiae with broad band, terga with rather thin, complete bands (T1 and T2 sometimes with bands briefly interrupted medially, remaining terga with bands slightly emarginate medially on anterior margin), and sides of S2–S5 with small lateral spot. Wings hyaline, slightly brownish; veins and stigma dark brown. *Pubescence.* Whitish, except ferruginous hairs on frons, vertex, dorsum of mesosoma, pronotal lobe, sides of metanotum, and inner surfaces of tarsi. Outer surfaces of basitarsi densely covered by tomentum (integument not visible among hairs), sparser on hind basitarsus. *Sculpturing.* Propodeal triangle dull, finely imbricate. T1–T5 with strongly elevated discal areas, dull or weakly shiny, weakly imbricate between dense punctures ( $\leq 1 \times$  PW); depressed marginal zones uniformly and densely punctate, punctures nearly contiguous; distal margins dull, very narrow ( $\leq 1 \times$  PW), broadest on T1, nearly absent on T5.

*Male.* Body length 13.0–14.0 mm; forewing length 7.7–8.3 mm. *Structure.* F1  $1.7 \times$  longer than broad, shorter ( $0.8 \times$ ) than combined lengths of F2 and F3. Lateral spine of T6 gently curved, stouter than and about as long as submedial spine of T7, apically blunt, not distinctly pointed; lateral lobe and submedial spine of T7 spiniform, median spine absent (Fig. 37); S4 without apical brush, distal margin straight; S6, in ventral view, with straight basal margin, laterally with long, apically truncated, laterally directed projection, distal margin straight or nearly straight, slightly emarginate medially (Fig. 368); S7 hemisternite apically pointed (Fig. 444); S8 basally broad, with distinct submedian lobe on distal margin, median lobe nearly twice as broad as long (Fig. 521). Genitalia: much broader than long, gonobase short, gonostylus about  $3.0 \times$  longer than broad, laterally compressed, about same width across length, apically curved; volsella reduced or absent, barely indicated by raised ridge; penis valve about  $2.0 \times$  gonostylar length, flattened, distally curved, bifid, dorsal lobe longer, weakly sclerotized, apically

with small curved projection, bridge broader laterally, with short, pointed lateral projection, dorsoapical patch of hairs and medial projection absent. *Sculpturing*. Ventral surface of mesepisternum sparsely papillate. *Coloration*. As in female, except yellow on clypeus, anterior surface of scape, ventral surface of fore coxa with small apical spot, ventral and lateral surfaces of coxae with large spots, and basitarsi.

*Distribution*: ARGENTINA: Corrientes, Misiones; PARAGUAY: Asunción, Cordillera, San Pedro (100–200 m a.s.l.). Recorded from Humid Chaco and Alta Paraná Atlantic forests ecoregions.

*Phenology*: December, January, March.

*Comments*: This species is resurrected from synonymy under *A. latum* (Moure & Urban, 1964); both species are quite distinct and easy to recognize, as indicated in the key to species. Strand's original description of this species was based on both males and females. To stabilize the name, a lectotype is herein designated with label data for the specimen as follows: 'Asuncion, Paraguay, 17.I.06 (January 17, 1906), Garten, J.D. Anisits // *Anthidium insignissimum* Strand det. ♂ // Type (red label) // Zool. Mus. Berlin // Lectotype *Anthidium insignissimum* Strand Des. V.H. Gonzalez & T. Griswold 2009'.

The mandible of the female has a distinct transverse ridge at the base of the basal teeth that runs parallel with the fimbriate line, on the inner surface of the mandible. Such a ridge, found to some extent in *A. meloi* sp. nov., is not developed in other *Anthidium* species, but is commonly found in some species of *Osmia* and *Megachile* with leaf-cutting behaviour.

#### *ANTHIDIUM ISABELAE* URBAN, 2004

FEMALE, FIGS 84, 164

*Anthidium isabelae* Urban, 2004: 491 (holotype: DZUP; ♀, Rondinha, Santa Catarina, Brazil).

*Diagnosis*: This species is known only from the female. *Anthidium isabelae* is easily recognized by the following combination of characters: clypeus prominently convex, with the epistomal suture basally curved (Fig. 84); tibial carina present; and shape of T6 (Fig. 164).

*Description: Female*. Body length 10.1 mm; forewing length 7.0 mm. *Structure*. Clypeus prominently convex, projected about 0.5× width of compound eye in profile, epistomal suture basally curved, distal margin thin, wavy (Fig. 84); mandible with six teeth; labrum gently elevated basally, not tuberculate; F1

1.8× longer than broad, slightly shorter (~0.8×) than combined lengths of F2 and F3. Tibial carina present. T6 straight or nearly straight in profile, lateral margin gently merging onto distal margin, without distinct lateral angle or spine, depressed apical rim projecting about one-quarter of distal margin, median emargination shallow (Fig. 164). *Coloration*. Black, except ferruginous on antenna (excluding six distal flagellomeres), tegula and legs excluding coxae, trochanters, most of femora, and outer surfaces of tibiae; yellow as follows: outer surface of mandible, broad, medially interrupted band on vertex, anterolateral margin of scutum, axilla, distal margin of scutellum, T1 and T2 each with four spots, submedian spots smaller on T1, and T3–T5 with two submedian spots. Wings light orange basally, brownish distally; veins ferruginous basally, dark brown distally, including stigma. *Pubescence*. Whitish, light ferruginous to brownish on vertex, inner surfaces of tarsi, and centre of sternal scopa. *Sculpturing*. Propodeal triangle dull, finely lineolate to imbricate. T1–T5 with weakly elevated discal areas, weakly shiny between dense punctures (2–3× PW); depressed marginal zones with punctures as large as those on discal areas, but denser (1× PW); distal margins narrow (1–2× PW).

*Distribution*: BRAZIL: Santa Catarina. This species is known only from the holotype female.

*Phenology*: January.

#### *ANTHIDIUM JOCOSUM* CRESSON, 1878

FEMALE, FIGS 85, 165; MALE, FIGS 243, 307, 369, 445, 522; MAP, FIG. 579

*Anthidium jocosum* Cresson, 1878: 111 (holotype: ANSP 2388; ♂, Colorado, USA); Cresson, 1916: 121 (unnecessary lectotype designation).

*Anthidium xanthognathum* Cockerell, 1925a: 347 (holotype: CAS 1730; ♀, Mokelumne Hill, California, USA); Grigarick & Stange, 1968: 23 (synonymy with *jocosum*).

*Anthidium fontis* Cockerell, 1925a: 348 (holotype: CAS 1731; ♂, Soboba Springs, Riverside Co., California, USA); Grigarick & Stange, 1968: 23 (synonymy with *jocosum*).

*Diagnosis*: This species is most similar to *A. utahense* in the small body size (8–10 mm in body length), female basitarsi with outer surfaces not covered by dense tomentum, shape of female T6 (Fig. 165), and shape of male T7 (Fig. 243), genitalia, and sterna; however, in the female of *A. jocosum*, T6 is more broadly rounded on the distal margin, with a less projected depressed apical rim (Fig. 165), and the clypeus and inferior paraocular area lack yellow

markings (Fig. 85). The male of *A. jocosum* can be recognized by S4 with apical brush sparser (Fig. 307) and S6 with lateral lobe broader and less acute, often not distinctly darker or more sclerotized than the median lobe (Fig. 369). Also, the metasoma is often light-reddish brown in both sexes of *A. jocosum*, contrasting with the predominantly black head and mesosoma, whereas in *A. utahense* the metasoma is always black.

**Description: Female.** Body length 6.2–8.8 mm; forewing length 4.6–6.0 mm. **Structure.** Clypeus weakly to prominently convex, projected about 0.4× width of compound eye in profile, distal margin thin, straight or nearly straight, two lateralmost tubercles usually more distinctly projected (Fig. 85); mandible with five teeth; labrum without basal protuberances, preapical projections large, distinctly curved upwards; F1 1.7× longer than broad, slightly shorter (~0.8×) than combined lengths of F2 and F3. Tibial carina absent. T6 gently swollen in profile, without distinct lateral spine, preapical carina absent, depressed apical rim projecting on entire distal margin (Fig. 165). **Coloration.** Body black, except light-reddish brown on antennal flagellum, clypeal margin, apex of mandible, tegula, apices of femora, tibiae, outer surfaces of tarsi, and sometimes metasoma; ivory or yellow as follows: outer surface of mandible, rounded to oval spot laterally on vertex, pronotal lobe, anterior margin of tegula (sometimes also on lateral and posterior margins), axilla (usually reduced), distal margin of scutellum, except medially (sometimes reduced), outer surfaces of tibiae basally (sometimes on entire surface), T1–T5 with medially interrupted bands, laterally deeply notched on anterior margin (T1 notched on posterior margin or broken into four spots), and T6 sometimes with two diffuse submedian spots. Wings hyaline, slightly brownish; veins and stigma mostly dark brown. **Pubescence.** Whitish, except light ferruginous to yellowish hairs on vertex, scutum, axilla, scutellum, inner surfaces of tarsi, and sometimes S6. Outer surfaces of fore and middle basitarsi sparsely covered by tomentum (integument barely visible among hairs). **Sculpturing.** Propodeal triangle nearly smooth, shiny. T1–T5 with weakly elevated discal areas, smooth, shiny between coarse and dense punctures (1–2× PW); depressed marginal zones with punctures as large as those on discs, nearly contiguous; distal margins smooth, shiny, narrow (1–2× PW), slightly thickened, doubly carinate.

**Male.** Body length 8.5–8.8 mm; forewing length 5.7–5.9 mm. **Structure.** F1 1.3× longer than broad, shorter (0.5×) than combined lengths of F2 and F3; labrum with preapical projections larger than in female. Lateral spine of T6 straight or nearly straight, about as long as median spine of T7; lateral

lobe of T7 subquadrate, basally about 2.0× broader than distance between inner margin and median spine (Fig. 243); S4 with narrow (one-sixth sternal width), rather sparse, light-reddish brown hair brush, often hardly seen among sternal hairs, on nearly straight distal margin (Fig. 307); S6, in ventral view, with gently convex basal margin, lateral lobe blunt, often not more sclerotized than median lobe, median lobe broadly rounded, broader than long (Fig. 369); S7 hemisternite somewhat pointed distally (Fig. 445); S8 with long, narrow apical process, deeply bifid apically, with pointed lobes ventrally bent (~100°), shaped like a heron or egret's head in profile view (Fig. 522). Genitalia: gonostylus robust, 3.8× longer than broad, nearly straight, with somewhat pointed apex in profile view; volsella small, about one-third of gonostylar length, obliquely truncate, appearing triangular in ventral view; penis valve half of gonostylar length, dorsoapical patch of hairs present, medial projection small. **Coloration.** As in female, except ivory or yellow on inferior paraocular area, clypeus, except sometimes apical margin, outer surfaces of tibiae (usually reduced to basal and distal apices of hind tibia), and basitarsi; maculations on axilla and scutellum usually reduced or absent.

**Distribution:** USA: California, southern Nevada, Arizona, south-western New Mexico. MEXICO: Baja California, Sonora (50–1800 m a.s.l.). Found in the Great Basin shrub steppe, Mojave, Sonoran, and Chihuahuan deserts, California coastal sage and chaparral (drier parts on the margins of the southern San Joaquin Valley in cismontane California), and Sierra Madre Occidental pine–oak forest ecoregions, primarily (67%) in the Mojave and Sonoran deserts (Fig. 579). Although this species was described by Cresson (1878) based on a single male, ostensibly from Colorado, we have not seen specimens from or adjacent to that state. The presence of this species in Colorado is problematic (Scott *et al.*, 2011).

**Phenology:** Late March–early July; the period from April through first half of June accounts for 96% of the records.

**Floral records:** ASTERACEAE: *Baileya multiradiata*, *Baileya multiradiata* var. *pleniradiata*; *Bebbia juncea*; *Chaenactis fremontii*, *Encelia virginensis*; *Ericameria monactis*; *Erigeron divergens*; *Gutierrezia californica*; *Haplopappus cooperi*; *Hemizonia* sp.; *Lasthenia* sp.; *Stephanomeria* sp. BORAGINACEAE: *Cryptantha intermedia*; *Eriodictyon crassifolium*; *Phacelia crenulata*, *Phacelia distans*, *Phacelia ramosissima*. CACTACEAE: *Opuntia echinocarpa*. FABACEAE: *Lotus scoparius*; *Lupinus argenteus*, *Lupinus argenteus* var. *argenteatus*; *Prosopis* sp.;



*Trifolium repens*. LAMIACEAE: *Marrubium vulgare*; *Salvia carduacea*, *Salvia pachyphylla*. LOASACEAE: *Mentzelia involucrata*. MALVACEAE: *Sphaeralcea* sp. ONAGRACEAE: *Oenothera* sp. POLEMONIACEAE: *Eriastrum pluriflorum*, *Eriastrum diffusum*, *Eriastrum sparsiflorum*; *Gilia* sp. POLYGONACEAE: *Chorizanthe staticoides*; *Eriogonum fasciculatum*, *Eriogonum inflatum*. RHAMNACEAE: *Ceanothus* sp. PLANTAGINACEAE: *Penstemon* sp. ZYGOPHYLLACEAE: *Larrea tridentata*, *Larrea divaricata*.

**Comments:** As indicated in the diagnosis and description of the terga, the background colour of the metasoma varies in both sexes. Specimens from the Mojave Desert have a light-reddish brown metasoma with the depressed marginal zone translucent, whereas those from central California (Fresno County) and the Sonoran Desert of southern Arizona (Cochise County) and northern Mexico (Sonora) are dark brown to black, and opaque throughout.

#### ANTHIDIUM KOLLA SP. NOV.

FEMALE, FIG. 5B

**Diagnosis:** Both sexes of this species are most similar to those of *A. cafayate* sp. nov. and *A. calchaqui* sp. nov. in the clypeus, supraclypeal area, and frons sparsely covered with stiff, simple, apically curly or hooked hairs, body size ( $\leq 11$  mm in body length), coloration pattern (i.e. antenna, tegula, legs, and base of wings ferruginous, and T1–T4 with interrupted yellow or cream bands), and shape of female T6, and male T7 and S6. It can be easily separated from those species by the following characters: frons closely punctate in both sexes ( $\leq 1\times$  PW); female clypeus gently convex, not flattened (Fig. 5B); and male T7 with lateral lobe narrow, at most as wide as submedian emargination. In *A. cafayate* sp. nov. and *A. calchaqui* sp. nov. the frons is sparsely punctate, with distinct areas of dull or shagreened integument between punctures, the female clypeus is somewhat flattened in *A. cafayate* sp. nov. and distinctly flattened in *A. calchaqui* sp. nov., as in other areas of the face (Fig. 5C, D), and the lateral lobe of male T7 in both species is much wider than the submedian emargination.

**Description (paratypes in parentheses): Female.** Body length 11.5 mm (11.1–12.3); forewing length 8.5 (8.2–8.8). **Structure.** Face not distinctly flattened; clypeus gently convex, projected about  $0.4\times$  width of compound eye in profile, with distal margin thin, sublaterally projected (Fig. 5B); mandible with eight teeth (seven in some paratypes); labrum with low basal protuberances separated by more than width of protuberance, preapical projections large, distinctly curved upwards;

F1 about twice as long as broad, about as long as combined lengths of F2 and F3. Tibial carina present. T5 with distal margin medially notched (absent in paratypes); T6 distinctly elevated basomedially (absent in paratypes), without distinct lateral angle, distal margin truncate, depressed apical rim visible on about median one-quarter of distal margin. **Coloration.** Black, except yellow or cream maculations as follows: oval spot laterally on vertex, T1–T4 with medially interrupted bands, widely separated on T1, closest on T4, T5 with complete band medially notched on anterior and posterior margins; ferruginous on antenna, except darkened on most of scape and last apical three flagellomeres (scape nearly ferruginous in one paratype), tegula, apices of femora, and remaining segments of legs. Wings light orange basally, brownish distally, with weak coppery and violet reflections; veins ferruginous basally, including prestigma, dark brown distally. **Pubescence.** Black, except ferruginous hairs on ferruginous areas of body, excluding scape and apices of femora. Clypeus, supraclypeal area, and frons with simple, stiff, apically curly or hooked hairs intermingled with normal hairs, denser on clypeus. Outer surfaces of fore and mid basitarsi densely covered by tomentum (integument not visible among hairs). **Sculpturing.** Supraclypeal area and frons shagreened between coarse, nearly contiguous punctures ( $\leq 1\times$  PW), integument finely imbricate, clypeus shinier, with punctures smaller than on frons. Propodeal triangle finely lineolate, weakly shiny. T1–T5 with weakly elevated discal areas, smooth and shiny, nearly glossy between coarse, sparse punctures ( $2\text{--}3\times$  PW); depressed marginal zones more densely punctate than on discs ( $\leq 1\times$  PW); distal margins smooth, shiny, narrow ( $1\text{--}2\times$  PW); T6 coarsely, densely punctate ( $\leq 1\times$  PW), most punctures continuing into grooves distally.

**Male.** Body length 10.8–12.8 mm; forewing length 8.8–10.5 mm. **Structure.** F1  $1.8\times$  longer than broad, shorter ( $\sim 0.8\times$ ) than combined lengths of F2 and F3; preapical labral projections absent. Lateral spine of T6 gently curved, about as long as median spine of T7; lateral lobe of T7 about as broad as long, at most as wide as distance between inner margin and median spine, outer margin nearly straight, inner margin angled; S4 with dense, black hair brush on median one-eighth of straight distal margin; S6, in ventral view, with basal margin straight or nearly straight, laterally with small projection (visible after dissection), distal margin with strong sublateral lobe somewhat pointed in lateral view, medially with deep emargination, about  $3.0\times$  broader than deep; S7 hemisternite distally truncate; S8, in ventral view, with narrow apical process, about one-third width of distal margin basally, apex of apical process laterally compressed. Genitalia: gonostylus nearly  $3.0\times$  longer

than broad; volsella about three-quarters of gonostylar length; penis valve slightly shorter than gonostylus, apically narrow, pointed, dorsoapical patch of hairs absent, medial projection large, distinct. *Coloration*. As in female, except yellow or ivory on outer surface of mandible basally, inferior paraocular area, clypeus, except apical margin, and T6 with pair of diffuse submedian spots. *Pubescence*. As in female, except whitish hairs sometimes intermingled with black hairs on clypeus, paraocular area, scape, vertex, scutum, axilla, scutellum, mesepisternum (except ventrally), fore femur (sometimes also on outer surfaces of tarsi), and discs of T1–T3. *Sculpturing*. Terga shiner, distal margins broader than in female (narrow in two paratypes).

*Holotype*: ♀, ARG. (ARGENTINA) – Salta Alturas Amblayo 3200 m-XII.86 (Dec 1986), Fritz (AMNH).

*Paratypes*: 5 females, 3 males. ARGENTINA: Salta, 2♀, same data as holotype except Feb 1987 and Feb 1988; 1♀, Cuesta Obispo, Mar 1997, Fritz; 1♂ Cuesta Obispo, 3600 m a.s.l., 20 Mar 1985, Fritz; 1♀, Cuesta Obispo, 3600 m a.s.l., Mar 1996, Fritz; 1♀, Cuesta Obispo, 3600 m a.s.l., Feb 1988, Fritz; 1♀, Cuesta Obispo, 3600 m a.s.l., Jan 1988, Fritz; 1♂, Alt. de Tastil, 3100 m a.s.l., Mar 1996, Fritz. (AMNH, BBSL).

*Distribution*: ARGENTINA: Salta. Known only from high elevations (3100–3600 m a.s.l.) south-west of Salta. Recorded from the Central Andean puna and High Monte ecoregions.

*Phenology*: December–March.

*Etymology*: Named after the Kolla people currently living in the Andean region of the province of Salta, in northern Argentina.

*Comments*: The median emargination on the distal margin of T5, and the basomedial elevation on T6 of the female holotype, seem to be abnormal features because they are absent in other specimens.

#### ***ANTHIDIUM LABERGEI* SP. NOV.**

FEMALE, FIGS 86, 166; MALE, FIGS 244, 308, 370, 446, 523, 568; MAP, FIG. 579

*Diagnosis*: The female of this species closely resembles that of *A. collectum* in the terga dull, with depressed marginal zones densely punctate and distal margins very narrow. In addition to the characters indicated in the key, it can be separated from that species by the clypeus less convex with distal margin thicker (Fig. 86), and terga with finer punctation,

somewhat similar to that of *A. cockerelli*. The male is most similar to that of *A. palmarum* in the shape of S6 (Fig. 370) and S8 with simple apical process; however, it is easily distinguished by T7 with lateral lobe broad and rounded (Fig. 244), S4 with apical brush smaller (Fig. 308), S7 hemisternite with distal margin distinctly notched (Fig. 446), and S8 with apical process hooked (Fig. 523).

*Description (paratypes in parentheses): Female*. Body length 8.9 mm (6.5–10.3); forewing length 6.2 mm (5.2–7.2). *Structure*. Clypeus weakly convex, projected about 0.5× width of compound eye in profile, distal margin thin, nearly straight (gently concave in some paratypes) between distinctly projected sublateral tubercles (Fig. 86); mandible with five teeth; labrum without basal protuberances, preapical projections large, distinctly curved upwards; F1 1.6× longer than broad, shorter (0.8×) than combined lengths of F2 and F3. Tibial carina absent. T6 straight in profile, with gently swollen disc, without distinct lateral spine, minutely crenulate preapical carina barely indicated laterally, depressed apical rim barely visible on median half of truncate distal margin (Fig. 166). *Coloration*. Dark brown to black, except: light brown to ferruginous on tarsi; yellow as follows: outer surface of mandible (reduced in some paratypes), distal half of clypeus, except medially (sometimes also small spot on lower paraocular area), oval spot (1.0–1.5× OD) laterally on vertex, pronotal lobe, tegula, except inner margin and disc, distal half of scutellum, except medially, middle and hind coxae with small ventral spot (absent in some paratypes), superior surfaces of middle and hind femora with small apical spot, outer surfaces of fore and middle tibiae with broad band ending before apex, outer surface of hind tibia with broad band along posterior margin, T1 with four spots (medially interrupted band, laterally deeply notched on anterior margin), T2–T5 with medially interrupted band, laterally deeply notched on anterior margin, and T6 with two large submedian spots, each spot with thin, transversal lateral dark spot. Wings hyaline, slightly brownish; veins and stigma dark brown. *Pubescence*. Whitish, except yellowish hairs on vertex, scutum, axilla, scutellum, and inner surfaces of tarsi. Outer surfaces of basitarsi densely covered by tomentum (integument not visible among hairs). *Sculpturing*. Propodeal triangle shiny, finely imbricate–lineolate. T1–T5 with weakly elevated discal areas, weakly shiny, weakly imbricate between punctures (1–3× PW); depressed marginal zones with denser punctures than on discs ( $\leq 1\times$  PW); distal margins weakly shiny, about half width or less of depressed marginal zone, little differentiated from it, progressively decreasing in width on apical terga, narrowest on T5 ( $\leq 1\times$  PW).

*Male.* Body length 9.2–10.5 mm; forewing length 6.2–6.6 mm. *Structure.* F1 1.5× longer than broad, shorter (0.7×) than combined lengths of F2 and F3; labrum with preapical projections larger than in female. Lateral spine of T6 gently curved, about as long as median spine of T7; lateral lobe of T7 apically rounded, 1.5× broader than distance between inner margin and median spine (Fig. 244); S4 with dark-brown to black brush of short hairs on medially concave distal margin (~0.4× sternal width) (Fig. 308); S6, in ventral view, with basal margin gently projecting medially, without distinct lateral lobe, distal margin thickened laterally, median lobe small, apically notched (Fig. 370); S7 hemisternite distinctly notched on distal margin (Fig. 446); S8 with apical process tapering distally in ventral view, hooked in profile, about half width of distal margin basally (Fig. 523). Genitalia: gonostylus robust, 3.3× longer than broad, nearly parallel-sided in profile; volsella small, about one-third of gonostylar length, triangular in ventral view, truncate distally, pointed ventrally as seen in profile; penis valve half of gonostylar length, dorsoapical patch of hairs present, medial projection small (Fig. 568). *Coloration.* As in female, except yellow as follows: clypeus, anterior surface of scape, outer surfaces of fore and middle tibiae, and basitarsi, lateral margin of scutum with thin (0.2–0.4× OD) band about as long as tegula (sometimes absent), superior surfaces of femora with small apical spot, S2–S4 with small, usually diffuse spots laterally, and T7 usually with two large spots (sometimes reduced or absent).

*Holotype:* ♀, USA: Arizona: Cochise Co., Wilcox 16 m N, IV 9–77 *Phacelia*, F.D. Parker (BBSL).

*Paratypes:* 23 females, 13 males. MEXICO: Sonora, 1♂, Santa Ana, 8 mi S, 11 May 1953, R.C. Bechtel, E.I. Schlinger; USA: Arizona, Cochise Co., 1♀, Apache, 2 mi E, 30 Apr 1965, J.G. Rozen; 1♂, Benson, 7 mi W, 13 Apr 1987, F.D. Parker; 1♂, 1♀, Peloncillo Mountains, Skeleton Canyon, 1 May 2004, M.E. Irwin, F.D. Parker; 1♀, Portal, 20 mi S, 15 Apr 1965, *Phacelia*, G.E. Bohart, P.F. Torchio; 1♂, Skeleton Canyon Road, 12 May 1977, J.G. Rozen; 1♂, 2♀, Wilcox, 30 mi S, 14 Apr 1965, *Phacelia*, F.D. Parker; Graham Co., 1♀, Wilcox, 16 mi N, F.D. Parker; Santa Cruz Co., 4♂, Tubac, 14 Apr 1965, *Phacelia*, G. Bohart, P. Torchio; 10♀, Tubac, 14 Apr 1966, *Phacelia*, G.E. Bohart, P.F. Torchio; 4♂, 2♀, Tubac, 24 Apr 1966, *Phacelia*, R.W. Rust, N. Youssef, P.F. Torchio; New Mexico, Hidalgo Co., 1♀, Animas, 20 mi S, 13 May 1978, J.G. Rozen, B.L. Rozen; 1♀, Lordsburg, 3 mi W, 1 Apr 1981, *Cardaria*, U.N. Lanham, C.C. Lanham; 1♀, Rodeo, 2 mi S, 3 May 1975, J.G. Rozen; 1♀, Rodeo, 2 mi SW, 28 Apr 1963, *Hymenoxys*, B.

Vogel, S.M. Sutton; Texas, El Paso Co., 1♀, El Paso, 28 Apr 1927, J.O. Martin (AMNH, BBSL, CAS, SEMC, UCDC, UCM).

*Distribution:* USA: southern Arizona, southern New Mexico, extreme west Texas. MEXICO: northern Sonora (700–1500 m a.s.l.). Endemic to the Chihuahuan Desert and adjacent Sonoran Desert ecoregions (Fig. 579).

*Phenology:* April–early May.

*Etymology:* The specific epithet is a patronym honoring Dr Wallace E. LaBerge, distinguished bee specialist, who first recognized the novelty of this and other North American *Anthidium* species.

*Floral records:* ASTERACEAE: *Hymenoxys* sp., *Malacothrix* sp. BORAGINACEAE: *Phacelia* sp. BRASSICACEAE: *Cardaria* sp. MALVACEAE: *Sphaeralcea* sp.

#### ANTHIDIUM LAROCAI URBAN, 1998

##### FEMALE, FIGS 87, 167

*Anthidium larocai* Urban, 1998: 34 (holotype: DZUP; ♀, Serra do Roncador, Mato Grosso, Brazil).

*Diagnosis:* This distinctive species is known only from the female holotype. It resembles the North American species *A. utahense* in the small body size and punctuation of the metasoma, which is finely and densely punctate, with discal areas weakly elevated. It can be easily separated from *A. utahense* and all other *Anthidium* species by the clypeus strongly convex (Fig. 87), the presence of a hind tibial carina, basitarsi with outer surfaces densely covered by tomentum, and the shape of T6 (Fig. 167).

*Description: Female.* Body length 9.3 mm; forewing length 3.7 mm. *Structure.* Clypeus strongly convex, projected about 0.6× width of compound eye in profile, distal margin thin, wavy, two lateralmost tubercles distinctly projected (Fig. 87); mandible with four teeth; labrum gently elevated basally, preapical projections large, distinctly curved upwards; F1 1.6× longer than broad, slightly shorter (~0.8×) than combined lengths of F2 and F3. Tibial carina present. T6 straight in profile, with small but distinct lateral spine, preapical carina minutely crenulate, depressed apical rim projecting on 0.6× distal margin, median emargination shallow (Fig. 167). *Coloration.* Black, except dark-reddish brown on outer surface of antennal flagellum, femora, and tibiae; yellow as follows: outer surface of mandible, distal margin of clypeus with thin, medially interrupted band, inferior paraocular area with thin, basally curved band, short



band laterally on vertex, pronotal lobe with small spot, anterior margin of tegula, lateral margin of scutum with thin band next to tegula, axilla, distal margin of scutellum, except medially, T1 with four spots, T2–T5 with medially interrupted bands, laterally notched on anterior margin, and T6 with two submedian spots. Wings subhyaline, brownish; veins and stigma dark brown. *Pubescence*. Whitish. Outer surfaces of basitarsi densely covered by tomentum (integument not visible among hairs), sparser on hind basitarsus. *Sculpturing*. Propodeal triangle dull, finely lineolate to imbricate. T1–T5 with weakly elevated discal areas, dull to weakly shiny, finely imbricate between dense punctures (1–2× PW); depressed marginal zones with punctures nearly contiguous; distal margins dull, narrow ( $\leq 2\times$  PW).

*Distribution*. BRAZIL: Matto Grosso (300 m a.s.l.); known only from the holotype. Recorded from the Mato Grosso seasonal forests ecoregion.

*Phenology*: July.

*ANTHIDIUM LATUM* SCHROTTKY, 1902

FEMALE, FIGS 88, 168; MALE, FIGS 245, 371, 447, 524

*Anthidium latum* Schrottky, 1902: 447 (holotype: MZUSP; ♀, Jundiaí, São Paulo, Brazil).

*Anthidium codoense* Ducke, 1907: 81 (lectotype: MPEG; ♀, Codó, Maranhão, Brazil; not examined); Nascimento, 1979: 2 (type designation); Ducke, 1910: 101 (synonymy with *latum*).

*Anthidium latum* var. *asuncionanum* Strand, 1910: 545 (lectotype: ZMB; ♂, Sapucay, Asunción, Paraguay); Moure & Urban, 1964: 108 (synonymy with *latum*) (**new lectotype designation**).

*Anthidium variegatipes* Cockerell, 1927: 1 (holotype: USNM 29073; ♀, Canamina, La Paz, Bolivia); Moure & Urban, 1964: 109 (synonymy with *latum*).

*Diagnosis*: This species is most similar to *A. insignisimum* and *A. meloi* sp. nov. in the body size, punctuation of terga, and general shape of T6 of the female and T7 of the male. It can be easily separated from those species by the preoccipital carina behind the gena in both sexes, and female T6 shiny, sparsely punctate, with the preapical carina barely visible laterally (Fig. 168). The male can be recognized by T6 with lateral spine broad, obliquely truncate, as seen in dorsolateral view, and S6 laterally with long, narrow, laterally directed projections and a median lobe broad, parallel-sided, apically bifid (Fig. 371); in addition, the hind coxa is ventrally depressed and densely covered by short, stout, simple, dark-brown hairs.

*Description*: *Female*. Body length 10.8–11.1 mm; forewing length 7.8–8.2 mm. *Structure*. Clypeus prominently convex, projected about 0.5× width of compound eye in profile, distal margin swollen, (not distinctly depressed above margin), strongly tuberculate (Fig. 88); mandible with six teeth; labrum without basal and preapical protuberances or projections; F1 1.8× longer than broad, slightly shorter (0.9×) than combined lengths of F2 and F3; preoccipital border carinate on gena, sharp on vertex. Tibial carina present. T6 gently convex in profile, with small but distinct lateral spine, depressed apical rim projecting on nearly entire, gently convex, distal margin (Fig. 168); S6 laterally projected, gently surpassing distal margin of T7 in dorsal view. *Coloration*. Black, except dark-reddish brown on antennal flagellum, femora, and inner surfaces of fore and middle tibiae and sterna; yellow as follows: outer surface of mandible, distal half of clypeus, inferior paraocular area below level of tentorial pit, vertex and upper portion of gena with thin, usually reduced or broken band, margins of tegula (usually reduced or absent), anterolateral and lateral margins of scutum, with thin band (not forming a continuous band, usually reduced to small spot on anterior margin), axilla, distal margin of scutellum, except medially, superior surfaces of femora with small apical spot, outer surfaces of fore and middle tibiae with thin band (usually broken or reduced to base), posterior margin of hind tibia with thin band ending well before apex, and terga, with rather thin, complete bands (sometimes broken into four small bands on T1, briefly interrupted medially on T2 and T3). Wings hyaline, slightly brownish; veins and stigma dark brown. *Pubescence*. Whitish, except: ferruginous hairs on inner surfaces of tarsi; brownish hairs on vertex, disc of scutum, axilla, scutellum, and S6. Outer surfaces of basitarsi densely covered by tomentum (integument not visible among hairs). *Sculpturing*. Propodeal triangle dull, finely imbricate. T1–T5 with strongly elevated discal areas, dull or weakly shiny, weakly imbricate between dense punctures (1–2× PW); depressed marginal zones uniformly and densely punctate, punctures nearly contiguous; distal margins dull, narrow (1–2× PW), decreasing in width towards apical terga, narrowest on T5.

*Male*. Body length 14.6 mm; forewing length 8.9 mm. *Structure*. F1 1.7× longer than broad, shorter (0.8×) than combined lengths of F2 and F3. Hind coxa ventrally depressed. Lateral spine of T6 broad, obliquely truncate in dorsolateral view; T7 with lateral lobe digitiform, submedian projection small, spiniform, median spine reduced or absent (Fig. 245); S4 without apical brush, distal margin straight; S6, in ventral view, with straight basal margin, laterally with long, narrow, laterally directed projection, distal

margin straight or nearly straight, strongly projecting into broad, parallel-sided, apically bifid median lobe (Fig. 371); S7 hemisternite as in Figure 447; S8 rectangular, parallel-sided, apically pointed with sinuous margins (Fig. 524). Genitalia: basally reduced, gonostylus digitiform, more than 10.0× longer than broad; volsella small, about one-fifth of gonostylar length, digitiform; penis valve longer than gonostylus, apically narrow, medially curved, dorsoapical patch of hairs and medial projection absent. *Coloration*. As in female, except yellow on sides of middle and hind coxae (usually with small spot) and basitarsi; maculations more developed on face, tibiae, and terga. *Pubescence*. Ventral surface of middle and hind coxae densely covered by short, stout, simple, dark-brown hairs.

*Distribution*: BOLIVIA, BRAZIL, and PARAGUAY (200 m a.s.l.). Recorded from Humid Chaco, Cerrado, Bolivian Yungas, Chiquitano dry forest, and Marañh o Babacu forest ecoregions.

*Phenology*: January, March–May, October, November.

*Comments*: Strand's original description of *A. latum* was based on both males and females. To stabilize the name, a syntype male is herein designated as the lectotype with the following label data: 'Asuncion, Paraguay, Sapucay, 12.I.05 (January 12, 1905), J.D. Anisits // Type (red label) // *Anth. latum* Schrttk. v. *asuncionanum* vn. Strand det. // Lectotype *Anthidium latum asuncionanum* ♂ Strand Des. V.H. Gonzalez & T. Griswold 2010'. The type of *A. codoense* could not be examined.

#### ANTHIDIUM LUIZAE URBAN, 2001

FEMALE, FIGS 89, 169

*Anthidium luizae* Urban, 2001b: 544 (holotype: DZUP; ♀, Puquio, Ayacucho, Peru).

*Diagnosis*: This species is only known from the female holotype. It can be confused with small specimens of *A. rubripes* by the body colour (black with largely ferruginous legs and T1–T4 with incomplete bands), hind tibia without carina, hind basitarsus without stout hairs on the outer surface, and sternal scopa black. It can be distinguished from *A. rubripes* by the clypeus with distal margin thinner, projected as a flat rim, as seen in profile (Fig. 89), and T6 not basally elevated on disc, with depressed apical rim less projected, narrower (one-third of distal margin), and distal margin more pointed (Fig. 169). Additionally, T5 has a yellow band, usually medially broken in *A. rubripes* and complete in *A. luizae*.

*Description: Female*. Body length 8.3 mm; forewing length 7.1 mm. *Structure*. Clypeus weakly convex, projected about 0.4× width of compound eye in profile, distal margin thin, straight, slightly projected sublaterally, projecting as flat rim, as seen in profile (Fig. 89); mandible with six teeth; labrum gently elevated basally, non tuberculate, preapical projections large, distinctly curved upwards; F1 1.9× longer than broad, as long as combined lengths of F2 and F3. Tibial carina absent. T6 straight in profile, with small but distinct lateral angle, preapical carina minutely crenulate, depressed apical rim visible on median one-third of distal margin (Fig. 169). *Coloration*. Black, except ferruginous on tegula and legs, excluding coxae, trochanters, and bases of femora; yellow as follows: rounded spot laterally on vertex, T1–T4 with medially interrupted bands, closer on apical terga, and T5 with complete band. Wings light orange basally, brownish distally; veins ferruginous basally, dark brown distally, including stigma. *Pubescence*. Black, except light ferruginous hairs on inner surfaces of basitarsi; whitish hairs on paraocular area, frons, most of mesosoma, T1, and disc of T2. *Sculpturing*. Propodeal triangle weakly shiny, finely lineolate to imbricate. T1–T5 with weakly elevated discal areas, weakly shiny between punctures (2–3× PW); depressed marginal zones with denser punctures than on discs (2–3× PW); distal margins shiny, narrow (2–3× PW).

*Distribution*: PERU: Ayacucho (~3400 m a.s.l.). Recorded from the Sechura Desert ecoregion.

*Phenology*: April.

#### ANTHIDIUM MACULIFRONS SMITH, 1854

FEMALE, FIGS 32, 90, 170; MALE, FIGS 40, 246, 309, 372, 448, 525; MAP, FIG. 579

*Anthidium maculifrons* Smith, 1854: 214 (holotype: BMNH 17A.1870: ♀, USA).

*Anthidium cognatum* Cresson, 1878: 109 (lectotype: ANSP 2382; ♂, Georgia, USA); Cresson, 1916: 115 (lectotype designation); Schwarz, 1928: 369 (synonymy with *maculifrons*).

*Anthidium zamoranicum* Cockerell, 1949: 448 (holotype: USNM 58489; ♂, Zamorano, Honduras); Griswold & Michener, 1988: 38 (synonymy with *maculifrons*).

*Diagnosis*: The female of this species is most similar to that of *A. cochimi* in T1–T5 with discal areas elevated and the shape of T6, as indicated in the key and the diagnosis of that species. It can be easily separated from *A. cochimi* by the clypeus more prominently convex and without modified hairs (Fig. 90),

the labrum with small but distinct preapical projections, and the outer surfaces of basitarsi with sparser tomentum. In *A. cochimi*, the clypeus is weakly convex and covered with thin, apically bent hairs, as on the supraclypeal area, the preapical labral projections are low, nearly absent, and the outer surface of the hind basitarsus is densely covered with tomentum. The male is easily distinguished from all other NW *Anthidium* by the hind coxa and trochanter with small ventral spine or tubercle (Fig. 40), T7 with lateral lobe digitiform (Fig. 246), S6 lateral and median discal carinae low (Fig. 372), and S8 with apical process long, bifid (Fig. 525).

**Description: Female.** Body length 9.2–11.2 mm; forewing length 6.6–8.0 mm. **Structure.** Clypeus prominently convex, projected about 0.5× width of compound eye in profile, distal margin gently tuberculate (Fig. 90); mandible with six or seven teeth; labrum with distinct basal protuberances separated by about width of protuberance, preapical projections small but distinct, curved; F1 1.8× longer than broad, shorter (0.8×) than combined lengths of F2 and F3. Tibial carina present. T6 gently convex in profile, usually with small, blunt lateral angle, preapical carina minutely crenulate, depressed apical rim visible on median one-third of distal margin (Figs 32, 170), not strongly projecting into a ventral lobe, as in *A. porterae*. **Coloration.** Dark brown to black, except yellow as follows: outer surface of mandible, distal half of clypeus, except medially, inferior paraocular area, broad band on vertex, pronotal lobe, anterior half of tegula, anterolateral and lateral margins of scutum (usually reduced or absent, not forming a continuous band), axilla, distal half of scutellum, except medially, outer surfaces of fore and middle tibiae with broad band ending well before apex, outer surface of hind tibia basally, T1–T5 with medially interrupted bands, deeply notched on anterior margin laterally (sometimes broken into four spots, usually on T1 and T2), and T6 with two large submedian spots. Wings hyaline, slightly brownish; veins and stigma dark brown. **Pubescence.** Whitish, except yellowish to brownish hairs on vertex, scutum, axilla, scutellum, inner surfaces of tarsi, and S6. Outer surfaces of basitarsi sparsely covered by tomentum (integument barely visible among hairs). **Sculpturing.** Propodeal triangle dull, finely imbricate–lineolate. T1–T5 with strongly elevated discal areas, dull or weakly shiny, weakly imbricate between punctures (2–3× PW); depressed marginal zones with coarse punctures as on discs, but denser ( $\leq 1.0\times$  PW); distal margins thick, doubly carinate, narrow (2–3× PW).

**Male.** Body length 9.2–16.9 mm; forewing length 5.7–10.3 mm. **Structure.** Labrum with basal protuberances slightly closer than in female, preapical projec-

tions larger than in female; F1 1.7× longer than broad, shorter (0.7×) than combined lengths of F2 and F3. Hind coxa and trochanter with small, ventral spine or tubercle. Lateral spine of T6 strongly curved, about as long as median spine of T7; lateral lobe of T7 digitiform (Fig. 246); S4 with small reddish brown apical hair brush (about one-tenth sternal width) on gently convex distal margin (Fig. 309); S6, in ventral view, with gently convex basal margin, distal margin sinuous, with low lateral and median discal carinae (Fig. 372); S7 hemisternite sinuous laterally, somewhat truncate apically (Fig. 448); S8 with long, broad, bifid apical process, about one-third width of distal margin basally (Fig. 525). **Genitalia:** gonostylus robust, 2.5× longer than broad, pointed in ventral and lateral views; volsella more than half of gonostylar length, ventrally and dorsally projected, gently convex distally; penis valve slightly shorter than gonostylus, with broad, flat apex, dorsoapical patch of hairs absent, medial projection small. **Coloration.** As in female, except yellow on clypeus, inferior paraocular area, anterior surface of scape, basitarsi, ventral spine of hind coxa, usually outer surfaces of tibiae (frequently reduced on hind tibia), and T7, with pair of diffused spots (sometimes ferruginous to dark brown, immaculate).

**Distribution:** COSTA RICA to southern USA (from Arizona, Colorado to Illinois, West Virginia, North Carolina, Georgia, Florida; 0–2500 m a.s.l.). Principally occupies dry forest and pine–oak ecoregions of Mesoamerica (43% of records) and forest ecoregions of the south-eastern USA (25%); absent from xeric regions (except Chihuahuan Desert) and other temperate forests. The most abundant and widely distributed *Anthidium* in Mesoamerica (Fig. 579).

**Phenology:** Year round; recorded in every month of the year; slight majority of records (54%) from August through first half of October.

**Floral records:** APOCYNACEAE: *Asclepias* sp. ASTERACEAE: *Bidens* sp.; *Coreopsis* sp. DIAPENSIACEAE: *Galax* sp. FABACEAE: *Afzelia* sp.; *Crotalaria* sp.; *Dalea foliosa*, *Dalea leptostachya*; *Galactia* sp.; *Phaseolus* sp.; *Psoralea* sp.; *Stylosanthes guianensis*; *Tephrosia virginiana*. LAMIACEAE: *Hyptis* sp. RUBIACEAE: *Diodia teres*.

**Biology:** Hungerford & Williams (1912) observed two *Anthidium* nests that they attributed to *A. maculifrons*, but Custer & Hicks (1927: 258) indicated that the species studied by those authors was *A. porterae* not *A. maculifrons*. The nests were built inside subhorizontal tunnels (12–25 cm in depth) in the ground.



Each nest had a single cell at the bottom of the tunnel, and the nest plug was made of trichomes from *Cirsium* (Asteraceae).

*Comments:* Two geographic morphs are apparent in the material examined. In females from the north-eastern portion of its range (from eastern USA to Texas) the clypeus is not strongly convex, and lacks a shiny longitudinal line medially, the scutum and terga are shiny, scutal punctures are dense but not contiguous, and on the depressed marginal zones of the terga punctures are distinctly separated and larger. In males from this region the scutum and terga are also shiny, and the punctures of the apical areas are at most slightly denser than on disc. In the rest of its range (southern Arizona and New Mexico, and south into Mexico and Central America) the scutum and terga are dull and contiguously punctate in both sexes, and in the female the clypeus is strongly convex with an impunctate line medially and the depressed marginal zones are finely, very densely punctate.

*ANTHIDIUM MACULOSUM* CRESSON, 1878

FEMALE, FIGS 91, 171; MALE, FIGS 247, 373, 449, 526; MAP, FIG. 580

*Anthidium maculatum* Smith, 1854: 216 (holotype: BMNH 17A.1852; ♂, Mexico) (preoccupied name).

*Anthidium maculosum* Cresson, 1878: 110 (lectotype: ANSP 2384; ♀, Utah, USA); Cresson, 1916: 122 (lectotype designation).

*Anthidium lupinellum* Cockerell, 1904b: 58 (holotype: AMNH; ♂, Pecos, New Mexico).

*Anthidium americanum* Friese, 1911: 395 (new name for *A. maculatum* Smith); Schwarz, 1928: 372 (synonymy with *maculosum*).

*Anthidium uyacanum* Cockerell, 1949: 448 (holotype: USNM 58490; ♀, Uyaca Mountain, Honduras); Griswold & Michener, 1988: 38 (synonymy with *maculosum*).

*Diagnosis:* The combination of hind tibial carina and frons dull with coarse, sparse punctures will separate this species from all other North American *Anthidium*, except *A. chamelense* sp. nov., *A. rodriguezi*, and *A. parkeri* sp. nov. From the former two species, *A. maculosum* can be separated in both sexes by the terga well maculated and the smaller body size. In the female it further differs by T6 with apical margin with only two teeth, and in the male by F1 slender, longer than F2 and F3 combined, and the mesepisternum ventrally without stout hairs or spines. *Anthidium maculosum* is most similar to *A. parkeri* sp. nov., from which it can be easily separated in the female by the outer surfaces of the basitarsi with denser tomentum and T6 slightly depressed above preapical carina,

with distinct lateral projections (Fig. 171). The male differs from *A. parkeri* sp. nov. in T7 with lateral lobe digitiform (Fig. 247), the shape of S6 (Fig. 373) and S8 (Fig. 526), and the scape without light maculations. The distal margins of the terga in both sexes of *A. maculosum* are also thin, almost lamellate, whereas they are unmodified in *A. parkeri* sp. nov.

*Description: Female.* Body length 8.5–11.5 mm; forewing length 7.7–9.2 mm. *Structure.* Clypeus weakly convex, projected about 0.4× width of compound eye in profile, distal margin straight or nearly straight (Fig. 91); mandible usually with seven teeth, rarely with six or eight teeth; labrum transversely elevated at base, without protuberances, preapical projections absent; F1 long and slender, 2.2× longer than broad, 1.2× longer than combined lengths of F2 and F3. Tibial carina present. T6 slightly depressed above minutely crenulate preapical carina, with small but distinct acute lateral projection (Fig. 171). *Coloration.* Dark brown to black, except yellow as follows: outer surface of mandible (sometimes extending along inferior margin), distal half of clypeus, except medially, rounded to oval spot laterally on vertex, tegula, except medially, distal third of scutellum, except medially, outer surfaces of tibiae basally (sometimes absent on hind tibia), and T1–T5 each with four widely separated subrectangular spots, larger and closer to each other on T5 (T6 usually immaculate). Wings hyaline, slightly brownish; veins and stigma dark brown. *Pubescence.* Mainly whitish, except brownish hairs on clypeus, supraclypeal area, frons, vertex, inner surfaces of basitarsi, depressed marginal zones of T1–T4, T5 and T6 entirely, and apex of S6. Clypeus, supraclypeal area, and frons covered with simple, apically curly or hooked hairs. Outer surfaces of basitarsi densely covered by tomentum (integument not visible among hairs), sparser on hind basitarsus. *Sculpturing.* Supraclypeal area and frons with integument dull between coarse, sparse (1–2× PW) punctures. Propodeal triangle dull, finely lineolate. T1–T5 with weakly elevated discal areas, dull or weakly shiny, weakly imbricate between punctures (2–3× PW); depressed marginal zones with smaller punctures, as on discs, but slightly denser (1–2× PW); distal margins dull, about as broad as depressed marginal zone, thin, almost lamellate.

*Male.* Body length 9.2–13.1 mm; forewing length 6.9–10.8 mm. *Structure.* Mandible with three teeth, second and third teeth about as far apart as first and second. Lateral spine of T6 strongly curved, longer, stouter than median spine of T7; lateral lobe of T7 digitiform (Fig. 247); S4 without apical brush, distal margin straight; S5 with distal margin straight or nearly straight; S6, in ventral view, with basal

margin straight, distal margin broadly rounded, with small, blunt, ventrally bent lateral projection (Fig. 373); S7 hemisternite slightly obliquely truncate distally (Fig. 449); S8 with apical process short, about one-quarter width of distal margin (Fig. 526). Genitalia: gonostylus robust, 2.0× longer than broad, broader apically; volsella more than half of gonostylar length, ventrally projected, distinctly swollen on inner margin; penis valve slightly shorter than gonostylus, with broad, flat apex, dorsoapical patch of hair absent, medial projection small. *Coloration*. As in female, except yellow as follows: outer surface of mandible, clypeus, except distal margin, inferior paraocular area, outer surface of middle tibia distally, outer surfaces of middle and hind basitarsi, and T6 and T7 usually with two submedian spots; maculations on scutellum sometimes reduced or absent. *Sculpturing*. As in female, except supraclypeal area and frons with finer, denser punctures, and terga slightly shinier.

*Distribution*: From HONDURAS to western USA: from Texas, Arizona, and California to western Oregon, Utah, and Colorado (0–3300 m a.s.l.). In Mexico commonly recorded from pine–oak forest ecoregions (60%); in USA present in hot deserts (18%), Great Basin and Colorado Plateau, Mediterranean California grassland, chaparral, and woodlands (19%), pine–oak forests (33%), and some other forest (21%; Sierra Nevada, Klamath–Siskiyou, Eastern Cascades, Great Basin, Arizona Mountains) ecoregions (Fig. 580).

*Phenology*: Mid February–November. The period from June through September accounts for 85% of records.

*Floral records*: AGAVACEAE: *Agave* sp. APIACEAE: *Angelica scabrida*. ASTERACEAE: *Aster* sp.; *Chaenactis douglasii*; *Chrysopsis villosa*; *Chrysanthamnus viscidiflorus*; *Cirsium calcareum*, *Cirsium vulgare*; *Corethrogyne flaginifolia*; *Ericameria linearifolia*; *Erigeron rhizomatus*; *Grindelia camporum*; *Gutierrezia sarothrae*; *Helianthus annuus*, *Helianthus floridanus*, *Helianthus maximiliani*; *Heterotheca villosa*; *Hulsea callicarpa*; *Isocoma acradenia*; *Senecio ionophyllus*, *Senecio spartioides*; *Solidago californica*. BORAGINACEAE: *Eriodictyon trichocalyx*; *Phacelia alba*, *Phacelia heterophylla*, *Phacelia pulchella*, *Phacelia ramosissima*, *Phacelia robusta*. CONVULVACEAE: *Convolvulus arvensis*. ERICACEAE: *Arctostaphylos* sp. FABACEAE: *Astragalus douglasii* var. *parishii*, *Astragalus flavus*; *Cercidium* sp.; *Dalea searlsiae*; *Lotus argophyllus*, *Lotus corniculatus*, *Lotus humistratus*, *Lotus nevadensis* var. *davidsonii*, *Lotus scoparius*, *Lotus strigosus*, *Lotus utahensis*; *Lupinus argenteus*; *Melilotus officinalis*; *Prosopis juliflora*; *Psoralea argemone*, *Psoralea scoparius*. IRIDACEAE: *Gladi-*

*olus* sp. LAMIACEAE: *Marrubium vulgare*; *Monarda austromontana*; *Monardella* sp.; *Poliomintha incana*; *Salazaria mexicana*; *Salvia dorrii*, *Salvia riparia*; *Stachys albens*, *Stachys bullata*, *Stachys pycnantha*; *Trichostema laxum*. MALVACEAE: *Sphaeralcea grossulariifolia*. OROBANCHACEAE: *Cordylanthus nevinii*. PLANTAGINACEAE: *Antirrhinum* sp. POLEMONIACEAE: *Gilia aggregata*. ROSACEAE: *Fallugia paradoxa*. PLANTAGINACEAE: *Penstemon linarioides*, *Penstemon thompsoniae* ssp. *jaegeri*. VERBENACEAE: *Verbena hastata*, *Verbena lasiostachys*.

*Biology*: The nest architecture and other aspects of the nesting biology were described by Krombein (1967), based on trap nests. The type of material used in the nest plug was variable, consisting of packs of trichomes only, or a combined plug consisting of trichomes followed by sections of pebbles, small pieces of wood, masticated plant material, or even pellets of lizard dung. Males are territorial at host plants preferred by females (Alcock *et al.*, 1977).

#### ANTHIDIUM MACUSHI SP. NOV.

FEMALE, FIGS 92, 172; MALE, FIGS 42, 48, 248, 374, 450, 527; MAP, FIG. 583

*Diagnosis*: This species is closely related to *A. sanguinicaudum*, as suggested by the almost identical shape of T6 of the female (Fig. 172) and genitalia (Fig. 48), and associated sterna (Figs 374, 450, 527) of the male. In addition to the apparent disjunct distribution of these species, the female of *A. macushi* sp. nov. can be reliably separated by the clypeus, which has simple, apically curved hairs on disc and straight distal margin, not distinctly projected sublaterally (Fig. 92). The male can be easily separated by S6 with distal margin thicker, without a small, ventrally directed spine (Fig. 374); the apical brush of S4 is also slightly broader and denser than in *A. sanguinicaudum* (compare Figs 42 and 325).

*Description*: *Female*. Body length 8.5–10.0 mm; forewing length 6.2–6.9 mm. *Structure*. Clypeus weakly convex, projected about 0.4× width of compound eye, distal margin thin, straight, not distinctly projected sublaterally (Fig. 92); mandible with six or seven teeth; labrum gently tuberculate basally, preapical projections absent, barely indicated by elevated border on lateral margin of furrow; F1 1.8× longer than broad, slightly shorter (~0.8×) than combined lengths of F2 and F3. Tibial carina present. T6 straight in profile, with small but distinct lateral spine, depressed apical rim projecting on almost entire, convex distal margin (Fig. 172). *Coloration*. Black, except ferruginous on tegula (sometimes darkened), legs (coxae usually darkened), and sterna;

yellow as follows: outer surface of mandible, distal two-thirds of clypeus, except medially (sometimes broadly interrupted), inferior paraocular area, anterior surface of scape (sometimes reduced), short band laterally on vertex, pronotal lobe, anterior margin of tegula, anterolateral and lateral margins of scutum with continuous broad band (sometimes interrupted or reduced), axilla, distal margin of scutellum, outer surfaces of tibiae (usually with broad band ending before apex), T1–T3 with medially interrupted bands (broken into four spots in one paratype), T4 and T5 with complete bands, and T6 entirely, except lateral and distal margins. Wings hyaline, slightly brownish; veins and stigma dark brown. *Pubescence*. Whitish, except light ferruginous hairs on inner surfaces of tarsi and discs of terga; dark-brown hairs on vertex, discs of scutum, and scutellum, depressed marginal zones of T1–T5, and distal margin of S6. Clypeus with simple, apically curved hairs. Outer surfaces of basitarsi densely covered by tomentum (integument not visible between hairs). *Sculpturing*. Propodeal triangle minutely punctate, dull. T1–T5 with weakly elevated discal areas, dull, weakly imbricate between dense punctures ( $1\text{--}2\times$  PW); depressed marginal zones slightly more densely punctate than on discs ( $\leq 1\times$  PW); distal margins dull, narrow ( $2\text{--}3\times$  PW), narrowest on T5 ( $\leq 1\times$  PW).

*Male (paratypes in parentheses)*. Body length 10.8 mm (10.0–13.1); forewing length 7.2 mm (7.0–8.5). *Structure*. F1  $1.6\times$  longer than broad, shorter ( $0.7\times$ ) than combined lengths of F2 and F3. Lateral spine of T6 straight, about as long as median spine of T7; lateral lobe of T7 broadly rounded, more than  $2.0\times$  distance between inner margin and median spine, outer margin strongly convex, inner margin straight (Fig. 248); S4 without distinct apical brush, at most with two or three rows of thick, dark-reddish brown hairs on one-fifth of gently concave distal margin (Fig. 42); S6, in ventral view, with gently convex basal margin, laterally with small, ventrolaterally directed spine, distal margin medially projected, truncate, thick, without small, ventrally directed spine (Fig. 374); S7 hemisternite rounded, somewhat truncate distally (Fig. 450); S8 with apical process broadly expanded distally, slightly more than half width of distal margin (Fig. 527). Genitalia: gonostylus robust, about  $3.0\times$  longer than broad; volsella large, about half of gonostylar length, apically rounded, dorsally with small basal projection; penis valve slightly shorter than gonostylus, apex narrow, blade-like, apically pointed, dorsoapical patch of hairs absent, medial projection large, distinct (Fig. 48). *Coloration*. As in female, except yellow on clypeus (except small basal spot), anterior surface of scape, outer surfaces of tibiae and basitarsi, and T6 with complete band; T7 ferruginous. *Sculpturing*. Terga slightly shinier, with

broader distal margins than in female, about one-third width of depressed marginal zone.

*Holotype*: ♂, FRENCH GUIANA: Kourou, X-16–1976, C.D. Michener (SEMC).

*Paratypes*: 10 females, 17 males. BRAZIL: Roraima, 1♀, Serra Grande, 21–30 Oct 1992, D.W. Davis; 2♂, 1♀, Surumu, Sep 1966, M. Alvarenga, F.M. Oliveira. FRENCH GUIANA: 1♀, Kourou, 11 Jul 1977, C.D. Michener; 1♂, Kourou, 16 Oct 1976, C.D. Michener; 1♂, Kourou, 22 Jul 1977, C.D. Michener; 6♂, 4♀, Kourou, 7 Oct 1976, C.D. Michener; 1♀, Kourou, 16 Jul 1976, D.W. Roubik; 1♀, Kourou, 11 km SW, 10 Jul 1977, C.D. Michener; 1♀, Kourou, 18 km NW, 23 Sep 1976, D.W. Roubik; 1♂, Kourou, 6 km SW, 20 Dec 1976; 3♂, Montagne Des Peres, Kourou, 10 Oct 1976, Otis, Winston, Michener; 1♂, 2♀, Sinnamary, 14 km SE, 8 Oct 1976, Winston, Otis, Michener. SURINAME: Saramacca, 3♀, Saramacca, 15–25 Sep 2005, G. Stecke. (SEMC, BBSL, DZUP, FSAC).

*Distribution*: FRENCH GUIANA and northern BRAZIL: Roraima (0–300 m a.s.l.). Recorded from Guianan savanna, Guianan moist forests, Guianan freshwater swamp forests, and Amazon–Orinoco–Southern Caribbean mangrove ecoregions (Fig. 583).

*Phenology*: February, July–October, December.

*Etymology*: This species is named after the Macushi people, an ethnic group of southern Guiana and northern Brazil.

#### *ANTHIDIUM MANICATUM* (LINNAEUS, 1758)

FEMALE, FIGS 1, 93, 173; MALE, FIGS 34, 249, 310, 375, 451, 528; MAP, FIG. 3

*Apis manicata* Linnaeus, 1758: 577 (holotype: LS; ♂, Europe).

*Diagnosis*: Both sexes of this species can be distinguished from all other NW *Anthidium* by the terga with broadly interrupted yellow bands, becoming progressively closer on apical segments, and thus forming a distinctive black, broad V-shaped area across terga (Fig. 34). In addition, females can be distinguished by the following combination of characters: clypeus with distal margin strongly tuberculate (Fig. 93), with simple, apically curly hairs, as on supraclypeus and frons; basitarsi with outer surfaces densely covered by dense tomentum; and hind tibia with carina. Males are easily recognized by the T2–T5 with strong lateral protuberances, surmounted by tufts of long hairs, and the T7 with spiniform projections strongly curved (Fig. 34).



*Description: Female.* Body length 9.2–12.2 mm; forewing length 7.8–8.9 mm. *Structure.* Clypeus weakly convex, projected about 0.5× width of compound eye in profile, distal margin strongly tuberculate (Fig. 93); mandible with six teeth; labrum with low basal protuberances, preapical projections large, distinctly curved upwards; F1 1.7× longer than broad, shorter (0.9×) than combined lengths of F2 and F3. Tibial carina present. T6 slightly depressed on disc, without distinct lateral spine, preapical carina minutely crenulate, depressed apical rim projecting on median one-third of somewhat truncate distal margin (Fig. 173). *Coloration.* Dark brown to black, except light-reddish brown on distal two-thirds of middle and hind femora (sometimes also on superior margin of fore femur and anterior margin of fore tibia); yellow as follows: outer surface of mandible, clypeus, except distal margin, base and along midline, lower paraocular area, rounded to oval spot laterally on vertex (sometimes short band), pronotal lobe, anterior half and posterior end of tegula, anterolateral and lateral margins of scutum, with continuous band (sometimes reduced), axilla (sometimes reduced), distal half of scutellum, except medially (sometimes reduced), hind coxa with small lateral spot, lower margins of middle and hind femora distally, outer surfaces of fore and middle tibiae, posterior margin of hind tibia, and terga with bands broadly interrupted medially, progressively closer towards apical segments. *Pubescence.* Yellowish to light ferruginous, except paler hairs on sides of mesosoma and S1–S5. Outer surfaces of basitarsi densely covered by tomentum (integument not visible among hairs). Clypeus, supraclypeus, and lower paraocular area with erect, simple, apically wavy hairs. *Sculpturing.* Propodeal triangle weakly shiny, finely imbricate to lineolate. T1–T5 with weakly elevated discal areas, shiny, weakly imbricate between coarse punctures (1–2× PW), punctures smaller, denser on terminal terga; depressed marginal zones with finer, denser punctures than on discs; distal margins narrow (1–2× PW).

*Male.* Body length 12.3–17.7 mm; forewing length 8.2–10.8 mm. *Structure.* Labrum transversely elevated at base, weakly concave medially, preapical projections reduced, barely indicated by elevated border on lateral margin of furrow; F1 1.7× longer than broad, shorter (0.7×) than combined lengths of F2 and F3. Fore femur with inferior margin carinate; hind trochanter strongly projected posteriorly. T2–T5 with discal areas usually strongly protuberant laterally; lateral spine of T6 strongly curved, longer, stouter than median spine of T7; lateral lobe of T7 spiniform (Fig. 34, 249); S4 with small reddish brown apical brush (about one-tenth sternal width) on straight distal margin (Fig. 310); S6, in ventral view, with gently convex basal margin, laterally with small,

blunt projection, distal margin medially projected, somewhat sinuous (Fig. 375); S7 hemisternite as in Figure 451; S8 with long, narrow, bifid apical process, ventrally bent in profile (Fig. 528). Genitalia: gonostylus robust, 3.0× longer than broad; volsella small, about one-third of gonostylar length, apically narrowed in profile view; penis valve slightly shorter than gonostylus, apically broad, flat, dorsoapical patch of hairs distinct, medial projection small. *Coloration.* As in female, except: yellow on clypeus, basitarsi, and sometimes T7; dark brown to black on hind and middle femora; maculations on femora, scutum, scutellum, axilla, and T1–T3 usually reduced. *Pubescence.* Lateral protuberances of T2–T5 densely covered with tufts of long ferruginous or pale hairs. *Sculpturing.* Terga with punctures finer and sparser, smoother and shinier between punctures, with broader distal margins than in female.

*Distribution:* USA, PERU, and south-eastern BRAZIL (0–2000 m a.s.l. in the Americas). Highly invasive species, apparently accidentally introduced into north-eastern USA and now transcontinental (Fig. 3). Because of its demonstrated ability to colonize populated places, it is likely to be found elsewhere in the Americas, and as it is restricted to human-modified habitats, association with ecoregions is irrelevant. The potential global distribution of this species was studied by Strange *et al.* (2011). We have not seen any specimen from Argentina, although it has been suggested that the species is also adventive there (Michener, 2007).

*Phenology:* Late January–early November; majority of records (85%) from June through September.

*Floral records:* ACANTHACEAE: *Acanthus* sp. AMARANTHACEAE: *Gomphrena globosa*. ASTERACEAE: *Aster* sp.; *Cirsium* sp.; *Erigeron* sp.; *Gaillardia* sp.; *Senecio cineraria*; *Solidago* sp. BORAGINACEAE: *Echium vulgare*. CRASSULACEAE: *Sempervivum tectorum*. FABACEAE: *Baptisia alba*; *Lotus corniculatus*; *Lupinus polyphyllus*; *Robinia hispida*; *Trifolium* sp. LAMIACEAE: *Ballota nigra*; *Caryopteris clandonensis*; *Galeopsis tetrahit*; *Lamium maculatum*, *Lamium maculatum alba*; *Melissa officinalis*; *Nepeta cataria*, *Nepeta mussinii*; *Ocimum basilicum*; *Perovskia atriplicifolia*; *Physostegia virginiana*; *Salvia farinacea*, *Salvia haematodes*, *Salvia horminum*, *Salvia officinalis*, *Salvia pratensis*, *Salvia superba*; *Stachys grandiflora*, *Stachys byzantina*. LYTHRACEAE: *Cuphea* sp.; *Lythrum salicaria*. MALVACEAE: *Lavatera* sp. PLANTAGINACEAE: *Antirrhinum majus*; *Digitalis purpurea*; *Linaria purpurea*, *Linaria vulgaris*; *Penstemon digitalis*; *Veronica* sp. Verbenaceae: *Caryopteris × clandonensis*.

**Biology:** The biology of this invasive species was studied by Kurtak (1973) in New York, USA. A total of 37 plant species (11 plant families) visited for pollen, nectar, or both was recorded in that work. Females collected trichomes from the following plants: *Echinops exaltatus* (Asteraceae), *Lychnis coronaria* (Caryophyllaceae), *Pelargonium* sp. (Geraniaceae), *Populus deltoids* (Salicaceae), and *Stachys byzantine* (Lamiaceae). Females show a preference for nest-cavity nesting sites high above the ground (Payne, Schildroth & Starks, 2011). Males exhibit territorial behaviour centred on female host plants (Pechuman, 1967), and are known for their violent attacks on other bees (Wirtz *et al.*, 1988).

**Comments:** The several names synonymized under this species are found in Warncke (1980) and Schwarz *et al.* (1996).

#### **ANTHIDIUM MAPUCHE SP. NOV.**

FEMALE, FIGS 30, 94; MALE, FIGS 44, 250, 311, 452, 529, 569; MAP, FIG. 583

**Diagnosis:** The female of this species is most similar to *A. adriani*, *A. rubripes*, and *A. sparsipunctatum* sp. nov., from which it can be separated by the following combination of characters: clypeus with distal margin distinctly thick, broad, and flattened medially (Fig. 94); outer surfaces of hind tibia and basitarsus sparsely covered with distinctly shorter and thicker hairs than those on the anterior margin; and T6 nearly straight in profile, with small lateral angle and translucent depressed apical rim projecting on median half, or slightly more, of somewhat truncate distal margin (Fig. 30). The male is most similar to that of *A. decaspilum* (especially in maculated specimens) in the T7 with lateral lobe subtriangular, shape of S4–S8, and genitalia. However, in *A. mapuche* sp. nov., S4 has a slightly smaller apical brush (0.20× versus 0.28–0.30× sternal width in *A. decaspilum*; Fig. 311), and S6 has more acute lateral projections and a slightly less projected distal margin medially (compare Figs 44 and 354). The male of *A. mapuche* sp. nov. can also be confused with that of *A. adriani*, *A. rubripes*, and *A. sparsipunctatum* sp. nov. by the body colour and shape of the lateral lobe of T7; however, in those species, the apical brush of S4 is reduced to a small tuft of hairs (about one-eighth of sternal width; Fig. 324), and S6 has a small, sharp, ventrally directed lateral angle and sinuous distal margin (Fig. 398).

**Description (paratypes in parentheses): Female.** Body length 11.5 mm (10.8–12.3); forewing length 7.8 mm (7.8–8.2). **Structure.** Clypeus weakly convex, projected about 0.4× width of compound eye in profile, distal margin distinctly thick, broad, flattened medially,

sublaterally projected (Fig. 94); mandible with six teeth (seven in some paratypes); labrum without basal protuberances, preapical projections small, tuberculiform; F1 about twice as long as broad, slightly shorter (–0.9×) than combined lengths of F2 and F3. Tibial carina absent. T6 nearly straight in profile, with very small lateral angle, preapical carina distinct, minutely crenulate, depressed apical rim translucent, projecting on median half (or slightly more) of somewhat truncate distal margin (Fig. 30). **Coloration.** Black, except ferruginous on antenna (darker on superior margin of distal segments), pronotal lobe, tegula, and legs, excluding coxae, trochanters, and bases of femora (outer surface of mandible light brown in some paratypes); yellow or cream as follows: broad band on vertex, T1–T4 with medially interrupted bands closer on apical terga, and T5 with two submedian spots. Wings light orange basally, brownish distally, with weak greenish, violet, and coppery reflections; veins ferruginous basally (including stigma and prestigma), dark brown distally. **Pubescence.** Mostly yellowish (whitish in some paratypes), except dark brown to black hairs on clypeus, ventral surface of mesepisternum, coxae, trochanters, and bases of femora (remaining areas of legs with ferruginous hairs); whitish hairs on gena, remaining areas of mesepisternum, metepisternum, sides of propodeum, and sides of basal four terga; black hairs on discs of basal four terga, T5, T6, and sterna. Fore basitarsus with sparse fringe of long hairs ( $\geq 2\times$  basitarsal width) along posterior margin. Outer surfaces of hind tibia and basitarsus sparsely covered with distinctly shorter, thicker hairs than those on anterior margin. **Sculpturing.** Propodeal triangle weakly shiny, lineolate to imbricate. T1–T5 with weakly elevated discal areas, smooth, shiny, somewhat glossy, sparsely punctate (2–4× PW); depressed marginal zones more densely punctate than on discs (1–2× PW); distal margins about one-quarter width of depressed marginal zone, little differentiated from it, broadest on T1 (about one-third width of depressed marginal zone), narrowest on T5 (2–3× PW).

**Male.** Body length 10.8–13.8 mm; forewing length 8.0–9.2 mm. **Structure.** F1 1.7× longer than broad, shorter (0.6×) than combined lengths of F2 and F3. Lateral spine of T6 nearly straight, about as long as median spine of T7; lateral lobe of T7 subtriangular, inner margin sometimes angled, about 1.5× broader than distance between inner margin and median spine (Fig. 250); S4 with small (0.2× sternal width) apical brush of dense, dark-brown to black, short hairs on gently projected distal margin (Fig. 311); S6, in ventral view, with basal margin straight, lateral lobe long, pointed, laterally directed, distal margin medially projecting into blunt apex (Fig. 44); S7 hemisternite as in Figure 452; S8 with short, gently

curved, simple apical process, basally broad, about one-third width of distal margin (Fig. 529). Genitalia: gonostylus robust, 3.0× longer than broad; volsella small, about one-third of gonostylar length, subrectangular, apex ventrally and dorsally gently projected; penis valve slightly shorter than gonostylus, apex curved, pointed, blade-like, dorsoapical patch of hairs reduced or absent, medial projection large, distinct. *Coloration*. As in female, except yellow or cream on outer surface of mandible, clypeus, inferior paraocular area, and T1–T4 with lateral bands deeply notched on posterior margin. *Pubescence*. Face, ventral surface of mesepisternum, coxae, base of fore basitarsus, and sides of T5 with whitish hairs.

*Holotype*: ♀, ARGENTINA: Chubut, Gobernador Costa, 27 km SE, Estancia El Condor, 21–31 Dec 2005., M.E. Irwin, Malaise trap (MLP).

*Paratypes*: 21 females, 5 males. ARGENTINA: Chubut, 1♂, same data as holotype; 1♀, Arroyo Mayoco, N of Esquel, 2900 ft, 20 Dec 2006, L. Packer; 1♀, Cholila; Chacra of Stephen Bussey, 23–31 Dec 2005, M.E. Irwin; 1♂, Sarmiento, 10 km E, Hwy 26, 27 Nov 2003, L. Packer; 4♀, Sarmiento, 24 km W, 21–31 Dec 2006, M.E. Irwin; Neuquén, 1♀, Dept Collon Cura, 31 km S La Rinconada, 25–27 Dec 2005, M.E. Irwin; 1♀, same except 24 Dec 2005–2 Jan 2006, M.E. Irwin; 1♀, Dept Collon Cura, 54 km S La Rinconada, 29 Dec 2005–2 Jan 2006, M.E. Irwin; 1♀, same except 2–4 Jan 2006, M.E. Irwin; 1♀, Junin de los Andes, nr., 10 km E on Ruta Provincial 49, 9 Dec 1998, *Discaria*, C. Porter; 3♀, Las Lajas, 17 km SE, 18 Nov 2008, *Adesmia adriani*, J.L. Neff; 1♂, 1♀, Parque Nacional Nahuel Huapi, La Lipela, 9 Dec 2000, *Adesmia*; 1♂, 6♀, Piedra del Aguila, 25 Nov 1989, Fritz; 1♀, Zapala, 10.2 km S, 17 Dec 1966, 1020 m a.s.l., E.I. Schlinger, M.E. Irwin; Santa Cruz, 1♂, 1♀, El Calafate, 195 m a.s.l., 2–11 Feb 1998, *Melilotus alba*, C. Vardy, M. Vardy; 1♀, Perito Moreno, E, 443 m a.s.l., 23 Dec 2006, L. Packer (AMNH, BBSL, CAS, CTMI, FSAC, MACN, PCYU).

*Additional material*: CHILE: Antofagasta, El Loa Prov., 1♀, San Pedro, 40 km NE; Cuesta del Diablo, 3800 m a.s.l., 26 Mar 2000, L. Packer; Bío-Bío, Ñuble Prov., 1♀, Las Trancas, Termas de Chillan, 14 Jan 1993, H. Toro; Maule, Curicó Prov., 1♂, El Planchón, 1–5 Feb 2003, A. Ugarte; Talca Prov., 1♀, L. Maule, W, 4 Jan 2009, L. Packer; 1♂, Laguna del Maule, 4 Jan 2009, L. Packer (AMNH, PCYU).

*Distribution*: CHILE: Bío-Bío, Maule. ARGENTINA: Chubut, Neuquén, Santa Cruz (200–3800 m a.s.l.). Recorded from Patagonian steppe, Valdivian temperate forest, Central Andean dry puna, and Chilean matorral ecoregions (Fig. 583).

*Phenology*: November–March.

*Floral records*: FABACEAE: *Adesmia* sp., *Melilotus alba*.

*Etymology*: This species is named after the Mapuche people who live in central and southern Chile and southern Argentina.

*Comments*: The new species and *A. decaspilum* appear allopatric. *Anthidium mapuche* sp. nov. occurs in southern Argentina, whereas *A. decaspilum* is found in north central Chile and the Province of Mendoza in north central Argentina. Given the similarity of the species, the records of *A. decaspilum* from southern Argentina indicated by Urban (2002) need to be confirmed.

#### *ANTHIDIUM MASUNARIAE* URBAN, 2001

FEMALE, FIGS 95, 174

*Anthidium masunariae* Urban, 2001b: 545 (holotype: DZUP; ♀, Acolla, Junín, Peru).

*Diagnosis*: The female of this species, which is only known from the holotype, is most similar to *A. cuzcoense*, in the fore and mid basitarsi densely covered with tomentum and the terga weakly shiny with distal margins broad. It can be separated from that species by the shape of T6 (Fig. 95; truncate in *A. masunariae* and medially projected in *A. cuzcoense*) and sternal scopa darker; additionally, *A. masunariae* has T1–T5 with medially interrupted bands, whereas there are four spots in *A. cuzcoense*; T6 of the latter species also has two submedian spots.

*Description*: *Female*. Body length 9.0 mm; forewing length 7.2 mm. *Structure*. Clypeus weakly convex, distal margin thin, straight or nearly straight, projecting as flat rim in profile (Fig. 95); mandible with six teeth; labrum gently elevated basally, without distinct basal protuberances, preapical projections large, distinctly curved upwards; F1 1.6× longer than broad, slightly shorter (~0.8×) than combined lengths of F2 and F3. Tibial carina weakly indicated, practically absent. T6 straight in profile, slightly depressed midapically, without distinct lateral angle, preapical carina minutely crenulate, semicircular depressed apical rim projecting on median one-third of truncate distal margin, median emargination sinuous, nearly absent (Fig. 174). *Coloration*. Black, except dark-reddish brown legs (tarsi lighter) and yellow maculations as follows: clypeus except distal margin and basal half, inferior paraocular area, small round spot laterally on vertex, and T1–T5 with medially interrupted bands, laterally notched on posterior margin, closer on apical terga. Wings hyaline, slightly brown-



ish; veins and stigma mostly dark brown. *Pubescence*. Whitish, except dark brown to black hairs on frons, vertex, dorsum of mesosoma, discs of T2–T4, remaining terga, and S3–S6; light ferruginous to brownish hairs on inner surfaces of tarsi. Outer surfaces of fore and middle basitarsi densely covered by tomentum (integument not visible among hairs). *Sculpturing*. Propodeal triangle dull, finely lineolate to imbricate. T1–T5 with weakly elevated discal areas, weakly shiny, finely lineolate between punctures (2–3× PW); depressed marginal zones with denser punctures than on discs (1–2× PW); distal margins dull, broad, about as wide as depressed marginal zone.

*Distribution*: PERU: Apurímac, Junín (3500–4100 m a.s.l.). Found in the Peruvian Yungas ecosystem.

*Phenology*: March, May.

*Comments*: A single male specimen deposited in CAS might belong to this species, based on coloration and distribution, but we hesitate to describe it here until more material is available and the sex association is confirmed. The male is very similar to that of *A. danunciae* sp. nov.: in fact, the genitalia and associated sterna of both species are almost identical. However, the terga are weakly shiny, T6 is not as densely and coarsely punctate, the yellow tergal bands are thinner, and the antenna, tegula, and base of forewing are dark brown. The complete label data for this specimen are as follows: 'Peru: 1♂, 35 Mi. E of Abancay, III-5–51 // Ross and Michelbacher Collectors // Cactus mesquite zone'.

#### **ANTHIDIUM MELOI SP. NOV.**

FEMALE, FIGS 16, 96, 175; MALE, FIGS 251, 376, 453, 530, 570

*Diagnosis*: This species is most similar to *A. insignissimum* in the female T6 dull, densely punctate, with preapical carina complete, male T7 with lateral lobe spiniform (Fig. 251), and male S6 with distal margin not projecting into a lobe (Fig. 376). The female can be easily separated by the clypeus more prominently convex (Fig. 96) and T6 with small but distinct lateral spine (Fig. 175). The male can be separated from *A. insignissimum* by the following characters: T6 with lateral spine slender and pointed; T7 with median spine reduced and lateral lobe narrower, pointed (Fig. 251); S8 basally narrower, with more developed lobate projections on distal margin (Fig. 530); and genitalia with the bridge of the penis valves about the same width across length, with lateral projections longer and more distinctive (Fig. 570). In addition, in both sexes of *A. meloi* sp. nov. the distal margins of the terga are broad, about one-quarter the width of

the depressed marginal zone, whereas they are very narrow (~1× PW) in *A. insignissimum*.

*Description (paratypes in parentheses): Female*. Body length 11.2 mm; forewing length 8.0 mm. *Structure*. Clypeus prominently convex, projected about 0.4× width of compound eye in profile, distal margin swollen (not distinctly depressed above margin), strongly tuberculate (Fig. 96); mandible with five teeth; labrum without basal and preapical protuberances or projections; F1 1.6× longer than broad, slightly shorter (0.8×) than combined lengths of F2 and F3; preoccipital border sharp, not distinctly carinate. Tibial carina present. T6 gently convex in profile, weakly elevated along midline, with small but distinct lateral spine, preapical carina present across gently convex distal margin, depressed apical rim projecting on entire distal margin, but only visible medially in dorsal view (Fig. 175); S6 laterally projected, gently surpassing distal margin of T7 in dorsal view (often obscured by hairs). *Coloration*. Black, except ferruginous on anterior surface of scape apically, F2–F10, tegula (sometimes darkened), ventral surface of mesepisternum and metepisternum, legs (fore coxa and outer surface of hind tibia and basitarsus darkened), and sterna; yellow as follows: outer surface of mandible, clypeus, except large basal U-shaped black spot, inferior paraocular area, vertex and upper portion of gena with complete band, pronotal lobe, margins of tegula, anterolateral and lateral margins of scutum with continuous broad band, axilla, distal margin of scutellum, sides of middle and hind coxae with small spot, inferior margin of fore femur with thin apical band (absent in paratypes), superior surfaces of fore and middle femora with small apical spot (also present on hind femur in one paratype), outer surfaces of fore and middle tibiae with broad band ending before apex, terga with rather thin, complete bands, slightly emarginate medially on anterior margin, and sides of S2–S5 with small lateral spot. Wings hyaline, slightly brownish; veins and stigma dark brown. *Pubescence*. Whitish, except ferruginous hairs on frons, vertex, dorsum of mesosoma, and inner surfaces of tarsi. Outer surfaces of basitarsi densely covered by tomentum (integument not visible among hairs), sparser on hind basitarsus. *Sculpturing*. Propodeal triangle dull, finely imbricate. T1–T5 with strongly elevated discal areas, dull or weakly shiny, weakly imbricate between dense punctures (1–2× PW); depressed marginal zones uniformly, densely punctate, punctures nearly contiguous; distal margins dull, about one-quarter width of depressed marginal zone, broadest on T1 (about one-third width of depressed marginal zone).

*Male*. Body length 13.1–14.6 mm; forewing length 7.7–9.4 mm. *Structure*. F1 1.7× longer than broad,

shorter (0.8×) than combined lengths of F2 and F3. Lateral spine of T6 gently curved, narrowed, pointed in lateral view, slight longer than submedian spine of T7; lateral lobe and submedian spine of T7 spiniform, median spine reduced, barely indicated (Fig. 251); S4 without apical brush, distal margin straight; S6, in ventral view, with straight basal margin, lateral projection long, apically truncate, laterally directed, distal margin straight or nearly straight, slightly emarginate medially (Fig. 376); S7 hemisternite apically pointed (Fig. 453); S8 basally broad, with distinct submedian lobe on distal margin, median lobe slightly broader than long (Fig. 530). Genitalia: much broader than long (Fig. 570), gonobase short, gonostylus about 3.0× longer than broad, laterally compressed, about same width across length, apically curved; volsella reduced or absent, barely indicated by raised ridge; penis valve about 2.0× gonostylar length, flattened, distally curved, bifid, dorsal lobe longer, weakly sclerotized, apically with small curved projection, bridge about same width across length, with long, hooked lateral projection, dorsoapical patch of hairs and medial projection absent. *Coloration*. As in female, except yellow on clypeus, base of supraclypeus, anterior surface of scape, F1, ventral surface of fore coxa, with small apical spot, ventral and lateral surfaces of middle and hind coxae with large spots, and basitarsi; T7 and distitarsi yellowish. *Pubescence*. Ventral surface of mesepisternum, metepisternum, and hind coxa densely covered by short, stout, simple, ferruginous to dark-brown hairs.

*Holotype*: ♀, PARAGUAY: Boquerón, Fn. Toledo, 22°21.471'S, 060°20.463'W, 4.ii.2007, 480 ft., E. Willis // (blue label) E. Willis, Voucher 34, Date 4.ii.07 (PCYU).

*Paratypes*: 2 females, 2 males. PARAGUAY: 2♀, 1♂, same data as holotype; 1♂, BOLIVIA: Santa Cruz, Boyuibe, 11 km N, 2900 ft, 20°23.75'S, 63°22.22'W, 6 Mar 1999, M. Irwin, F. Parker (PCYU, BBSL).

*Distribution*: PARAGUAY and eastern BOLIVIA: Santa Cruz (200–900 m a.s.l.). Recorded from the Dry Chaco ecoregion.

*Phenology*: February, March.

*Etymology*: This species is dedicated to our friend and colleague Dr Gabriel Melo, who has significantly contributed to the knowledge of the neotropical bee fauna.

#### *ANTHIDIUM MICHENERORUM* SP. NOV.

FEMALE, FIGS 97, 176; MALE, FIGS 35, 312, 377, 454, 531, 571; MAP, FIG. 579

*Diagnosis*: Both sexes of this species can be distinguished from all other NW *Anthidium* by the terga

coarsely and densely punctate, with distal margins doubly carinate, and in the female by the shape of T6 (Fig. 176); the male is easily distinguished by the S4 with apical brush broad, deeply concave (Fig. 312), and the shape of S6 (Fig. 377).

*Description (paratypes in parentheses): Female*. Body length 10 mm (9.5–9.7); forewing length 7.4 mm (6.9–7.4). *Structure*. Clypeus prominently convex, projected about 0.4× width of compound eye in profile, distal margin thin, wavy, two lateralmost tubercles more distinctly projected (Fig. 97); mandible with six teeth; labrum without basal protuberances, preapical projections large, distinctly curved upwards; F1 1.7× longer than broad, shorter (0.7×) than combined lengths of F2 and F3. Tibial carina absent. T6 convex in profile, without preapical carina, laterally with distinct blunt projection, distal margin gently convex, with deep, broad median emargination (Fig. 176). *Coloration*. Black, except dark-reddish brown on coxae to tibiae; light ferruginous on distitarsi; yellow or cream maculations as follows: outer surface of mandible, two large spots nearly connected medially on distal two-thirds of clypeus (spots connected or clypeus entirely yellow, with two submedian triangular dark-brown spots), inferior paraocular area (scape with small apical spot on anterior surface, sometimes reduced), oval spot (1.0–1.5× OD) laterally on vertex (sometimes extending to level of lateral ocellus), pronotal lobe, tegula except on disc, short (shorter than tegular length), narrow (~0.5× OD) band on lateral margin of scutum (also on anterolateral margin of scutum), distal margin of axilla, distal margin of scutellum, except medially, small spot apically on superior margins of middle and hind femora (two paratypes also with small band apically on inferior margins), broad band (1.2–1.5× OD), ending before apex on outer surfaces of fore and middle tibiae, and along posterior margin of hind tibia (reaching apex in two paratypes), outer surface of hind basitarsus, T1 with medially interrupted band, each lateral band with oval, dark-brown spot (dark spots sometimes reduced or absent), T2–T5 with complete, medially narrowed bands, laterally notched on anterior margin, and T6 with band slightly broken medially (complete in one paratype). Wings hyaline, slightly brownish; veins and stigma dark brown. *Pubescence*. Whitish, except light ferruginous to yellowish hairs on vertex, scutum, scutellum, axilla, inner surfaces of tarsi, and apex of S6. Clypeus and supraclypeal area covered with erect, simple, apically curved hairs. Outer surfaces of fore and mid basitarsi densely covered by tomentum (integument not visible among hairs). *Sculpturing*. Propodeal triangle nearly smooth, shiny. T1–T5 with strongly elevated discal areas, shiny, finely imbricate to nearly smooth

between coarse punctures (1–2× PW); depressed marginal zones with denser punctures ( $\leq 1\times$  PW) than on discs; distal margins smooth, shiny, narrow (2–3× PW), distinctly thickened, doubly carinate.

*Male.* Body length 9.4–14.3 mm; forewing length 6.9–7.7 mm. *Structure.* F1 1.5× longer than broad, shorter (0.6×) than combined lengths of F2 and F3; labrum with preapical projections longer than in female. Lateral spine of T6 straight or nearly straight, about as long as median spine of T7; lateral lobe of T7 apically rounded, about 1.5× broader than distance between inner margin and median spine (Fig. 35); S4 with apical brush of black, long hairs on broad, deep median emargination (Fig. 312); S6, in ventral view, with gently convex basal margin, laterally obliquely truncate, submedian and median lobes small, digitiform (Fig. 377); S7 hemisternite distally pointed (Fig. 454); S8 with broad apical process, about 0.4× width of distal margin basally, deeply bifid apically, with pointed lobes ventrally bent ( $\sim 100^\circ$ ) in profile view (Fig. 531). Genitalia: gonostylus robust, 3.3× longer than broad; volsella small, slightly less than one-third of gonostylar length, obliquely truncate, appearing triangular in ventral view; penis valve about half of gonostylar length, apex broad, flattened, dorsoapical patch of hairs present, medial projection small (Fig. 571). *Coloration.* As in female, except yellow maculations as follows: clypeus (sometimes with two small basal dark spots), labrum, with median spot basally (sometimes absent), anterior surface of scape (sometimes reduced), basitarsi and T7 with small lateral spot or transverse band (sometimes almost entirely yellow); maculations on scutum and axilla sometimes reduced or absent; coxae to tibiae sometimes black. *Pubescence.* Predominantly whitish, sometimes including inner surfaces of tarsi.

*Holotype:* ♀, USA: Oklahoma, Blaine Co., Roman Nose State Pk., Watonga, 17 May 1977, C.D. Michener, on *Astragalus gracilis* (SEMC).

*Paratypes:* 3 females, 11 males: USA: Kansas, Barber Co., 1♀, Hardtner, 16 mi W, 12 May 1962, *Astragalus racemosus*, C.D. Michener; Kiowa Co., 1♂, Greensburg, 13 S, 1 Jun 2002, G.A. Salisbury; Oklahoma, Blaine Co., 1♀, Okeene, 8 mi W, 17 May 1977, C.D. Michener; 4♂, Roman Nose State Park, Watonga, 17 May 1977, *Astragalus gracilis*, C.D. Michener; Ellis Co., 2♂, Four Canyons Preserve, 6 Jun 2009, *Psoralea cuspidata*, M. Arduser; Texas, Shackelford Co., 3♂, Albany, 5 Apr 1954, *Astragalus*, L.D. Beamer; Taylor Co., 1♂, Abilene, 7 Apr 1954, *Astragalus*, L.D. Beamer; 1♀, Abilene, 7 Apr 1954, *Astragalus*, R.H. Beamer (BSBL, MDC, SEMC).

*Distribution:* USA: southern Great Plains in Kansas, Oklahoma, Texas (400–700 m a.s.l.). Appears restricted to grasslands; recorded from the Western short and Central and Southern mixed grasslands, and Central forest–grassland transition ecoregions (Fig. 579).

*Phenology:* April–early June.

*Floral records:* FABACEAE: *Astragalus gracilis*, *Astragalus racemosus*; *Psoralea cuspidata*.

*Etymology:* This species is named for our beloved friends Charles and Mary Michener who, beyond significantly contributing to our understanding of bees, have greatly enriched our lives.

#### ANTHIDIUM MORMONUM CRESSON, 1878

FEMALE, FIGS 20, 98, 177; MALE, FIGS 252, 313, 378, 455, 532; MAP, FIG. 580

*Anthidium mormonum* Cresson, 1878: 110 (holotype: ANSP 2384; ♂, Utah, USA); Cresson, 1916: 126 (unnecessary type designation).

*Anthidium blanditum* Cresson, 1879: 206 (lectotype: ANSP 2397; ♀, Nevada, USA); Cresson, 1916: 113 (type designation); Michener, 1951: 1141 (synonymy with *mormonum*).

*Anthidium pondreum* Titus, 1902: 169 (holotype: PERC; ♂, Fort Collins, Colorado, USA; not examined); Grigarick & Stange, 1968: 25 (synonymy with *mormonum*).

*Anthidium pecosense* Cockerell, 1904c: 74 (holotype: AMNH; ♂, Pecos, New Mexico, USA); Grigarick & Stange, 1968: 25 (synonymy with *mormonum*).

*Anthidium bernardinum* var. *wilsoni* Cockerell, 1904c: 75 (holotype: AMNH; ♂, Mt. Wilson, California, USA); Grigarick & Stange, 1968: 25 (synonymy with *mormonum*).

*Anthidium bernardinum* var. *fragariellum* Cockerell, 1904c: 76 (holotype: AMNH; ♂, Strawberry Valley, California, USA); Grigarick & Stange, 1968: 25 (synonymy with *mormonum*).

*Anthidium blanditum praedentatum* Cockerell, 1907b: 99 (holotype: AMNH; ♀, Boulder, Colorado, USA); Michener, 1951: 1141 (synonymy with *mormonum*).

*Anthidium wallisi* Cockerell, 1913: 13 (holotype: CNC; ♀, Peachland, British Columbia, Canada); Grigarick & Stange, 1968: 25 (synonymy with *mormonum*).

*Anthidium nebrascense* Swenk, 1914: 14 (holotype: UNSM; ♀, ♂, Sowbelly Canyon, Sioux County, Nebraska, USA); Grigarick & Stange, 1968: 25 (synonymy with *mormonum*).



*Anthidium praedentatum trianguliferum* Swenk, 1914: 18 (holotype: UNSM; ♀, Fort Garland, Costilla County, Colorado, USA); Michener, 1951: 1141 (synonymy with *mormonum*).

*Anthidium flavicaudum* Cockerell, 1925a: 359 (holotype: CAS 1741; ♂, Sisson, California, USA); Grigarick & Stange, 1968: 25 (synonymy with *mormonum*).

*Anthidium wyomingense* Schwarz, 1927a: 20 (holotype: AMNH; ♀, Jackson, Wyoming, USA); Grigarick & Stange, 1968: 25 (synonymy with *mormonum*).

*Anthidium mormonum hicksi* Schwarz, 1934: 4 (holotype: AMNH; ♀, Pasadena, California, USA); Grigarick & Stange, 1968: 25 (synonymy with *mormonum*).

*Anthidium wallisi wallowana* Schwarz, 1940: 5 (holotype: CAS 12031; ♀, Wallowa National Forest, Oregon, USA); Grigarick & Stange, 1968: 25 (synonymy with *mormonum*).

**Diagnosis:** The female of this species is easily recognized by the following combination of characters: absence of a tibial carina, absence of dense tomentum on outer surfaces of basitarsi (Fig. 20), and T6 with depressed apical rim distinctly projected on median half of gently convex distal margin (Fig. 177). Males can be distinguished by the following combination of characters: T7 with lateral lobe apically rounded, sometimes gently curved (Fig. 252); S4 with apical hair brush reddish brown (Fig. 313); S6 with lateral lobe acute and median lobe broad (Fig. 378); and S8 with apical process long, slender, bifid (Fig. 532). Also, the ventral surface of the hind coxa is sometimes densely covered with short, stout, simple, brownish hairs, often obscured by longer, normal pale hairs. Smaller specimens of *A. mormonum* are similar to *A. utahense* but the shape of T6 of the female, shiny propodeal triangle in both sexes, and male T7 with lateral lobe subquadrate separate the latter species from *A. mormonum*.

**Description: Female.** Body length 8.0–11.2 mm; forewing length 5.5–8.8 mm. **Structure.** Clypeus prominently convex, projected about 0.5× width of compound eye in profile, distal margin thin, straight or weakly wavy, two lateralmost tubercles usually more distinctly projected (Fig. 98); mandible with five or six teeth; labrum gently elevated basally, not tuberculate, preapical projections large, distinctly curved upwards; F1 1.7× longer than broad, slightly shorter (~0.8×) than combined lengths of F2 and F3. Tibial carina absent. T6 with disc gently swollen basally in profile, without distinct lateral spine, depressed apical rim distinct, projecting on about median half of distal margin (Fig. 177). **Coloration.** Black, except: light-reddish brown on tarsi; yellow as follows: outer surface of mandible, clypeus, except distal margin and pair of

small basal spots, base of supraclypeal area (usually absent), inferior paraocular area, broad band on vertex (usually medially interrupted), pronotal lobe, upper half of mesepisternum (sometimes reduced or absent), anterior and posterior margins of tegula, anterolateral and lateral margins of scutum with continuous broad band, axilla, distal margin of scutellum, except medially, ventral surfaces of fore and middle coxae, ventral and lateral surfaces of hind coxa, femora to basitarsi (usually excluding anterior and superior surfaces of fore and middle femora, posterior and superior surfaces of hind femur, and inner surfaces of tibiae), T1–T5 with complete, medially narrowed bands (T1 usually with medially interrupted band, laterally notched on posterior margin), T6, except sublateral semilunar dark spots, and S2–S5 with round, sometimes diffuse yellow spots. Wings hyaline, slightly brownish; veins and stigma mostly dark brown. **Pubescence.** Whitish to light ferruginous, usually slightly darker on face, vertex, scutum, axilla, scutellum, inner surfaces of tarsi, and sides of propodeum. Clypeus and supraclypeal area covered with erect, simple, apically slightly curved hairs. Outer surfaces of fore and middle basitarsi sparsely covered by tomentum (integument barely visible among hairs). **Sculpturing.** Propodeal triangle dull, finely lineolate to imbricate. T1–T5 with strongly elevated discal areas, weakly shiny between dense punctures (1–2× PW); depressed marginal zones with nearly contiguous punctures; distal margins dull, narrow (1–2× PW), slightly thickened, doubly carinate (more evident on T1).

**Male.** Body length 7.7–13.0 mm; forewing length 6.0–8.8 mm. **Structure.** F1 1.5× longer than broad, shorter (0.6×) than combined lengths of F2 and F3. Lateral spine of T6 straight or nearly straight, about as long as median spine of T7; lateral lobe of T7 apically rounded, sometimes gently curved, 1.0–1.5× wider than distance between inner margin and median spine (Fig. 252); S4 with narrow (one-quarter sternal width), light-reddish brown apical brush, often hardly seen among sternal hairs, distal margin straight or nearly straight (Fig. 313); S6, in ventral view, with gently convex to nearly straight basal margin, lateral lobe pointed, posteriorly directed, median lobe broadly rounded, broader than long (Fig. 378); S7 hemisternite somewhat distally truncate (Fig. 455); S8 with long, narrow apical process, deeply bifid apically, with pointed lobes ventrally bent (~100°), heron or egret's head shaped in profile view (Fig. 532). **Genitalia:** gonostylus robust, 3.0× longer than broad; volsella small, less than one-third of gonostylar length, obliquely truncate, appearing triangular in ventral view, ventrally pointed in profile; penis valve about half of gonostylar length, apex broad, flattened, dorsoapical patch of hairs present, medial projection small. **Coloration.** As in female,

except yellow on anterior surface of scape (usually reduced or absent) and T7 with two large spots (sometimes entirely yellow); T1–T4 with medially interrupted bands, laterally notched on anterior margin (sometimes T1 with four spots); maculations on mesepisternum, scutum, axilla, and scutellum, usually reduced or absent. *Pubescence*. Hind coxa usually densely covered with short, stout, simple, brownish hairs on ventral surface, often obscured by longer, normal pale hairs.

*Distribution*: Western USA: Pacific Coast states to Montana, western South Dakota, western Nebraska, Colorado, New Mexico. Adjacent CANADA: British Columbia. Adjacent MEXICO: northern Baja California (0–3300 m a.s.l.). Largely restricted to forest (54% of records), Mediterranean California chaparral and woodlands (12%), and shrublands and shrub steppe (26%) ecosystems. Records from the Mojave Desert (5%) are all in the Spring Mountains of southern Nevada, at higher elevations (Fig. 580).

*Phenology*: March–early September; last half of May through August accounts for 97% of records.

*Floral records*: APIACEAE: *Perideridia* sp. ASTERACEAE: *Aster occidentalis*, *Aster occidentalis* var. *yosemitanus*; *Chaenactis douglasii*, *Chaenactis stevioides*; *Chrysothamnus viscidiflorus*; *Cirsium* sp.; *Ericameria bloomeri*, *Ericameria linearifolia*; *Erigeron acris* var. *debilis*, *Erigeron rhizomatus*; *Grindelia* sp.; *Haplopappus linearifolius*; *Hymenopappus filifolius*; *Rudbeckia hirta* var. *pulcherrima*; *Senecio* sp.; *Solidago* sp.; *Taraxacum officinale*. BORAGINACEAE: *Cryptantha intermedia*; *Emmenanthe penduliflora*; *Eriodictyon tomentosum*; *Phacelia alba*, *Phacelia ciliata*, *Phacelia hastata*, *Phacelia heterophylla*, *Phacelia heterophylla* ssp. *virgata*, *Phacelia humilis*, *Phacelia imbricata*, *Phacelia leptosepala*, *Phacelia magellanica*, *Phacelia malvifolia*, *Phacelia mutabilis*, *Phacelia pringlei*, *Phacelia ramosissima*. BRASSICACEAE: *Streptanthus tortuosus*, *Streptanthus tortuosus* var. *orbiculatus*, *Streptanthus tortuosus* var. *tortuosus*. CACTACEAE: *Opuntia* sp. CARYOPHYLLACEAE: *Stellaria borealis*. CRASSULACEAE: *Sedum obtusatum*. FABACEAE: *Astragalus aequalis*, *Astragalus gracilis*; *Dalea searlsiae*; *Lotus argophyllus* var. *fremontii*, *Lotus nevadensis*, *Lotus nevadensis* var. *davidsonii*, *Lotus oblongifolius*, *Lotus purshianus*, *Lotus scoparius*, *Lotus strigosus*, *Lotus utahensis*; *Lupinus argenteus*, *Lupinus bicolor*, *Lupinus breweri* var. *breweri*, *Lupinus lepidus* var. *confertus*, *Lupinus lepidus* var. *lobbii*, *Lupinus sericeus*; *Medicago sativa*; *Melilotus alba*, *Melilotus officinalis*; *Psoralea lanceolata*; *Thermopsis* sp.; *Trifolium repens*. GERANIACEAE: *Geranium richardsonii*, *Geranium viscosissimum*.

IRIDACEAE: *Sisyrinchium idahoense*. LAMIACEAE: *Marrubium vulgare*; *Mentha* sp.; *Monardella* sp.; *Poliomintha incana*; *Salvia dorrii* ssp. *dorrii* var. *clokeyi*; *Stachys albens*. MALVACEAE: *Sphaeralcea coccinea*. ONAGRACEAE: *Clarkia* sp. PHRYMACEAE: *Mimulus* sp. PLANTAGINACEAE: *Collinsia heterophylla*; *Keckiella breviflora*; *Penstemon angustifolius*, *Penstemon comarrhenus*, *Penstemon spectabilis*, *Penstemon thompsoniae* ssp. *jaegeri*. POLEMONIACEAE: *Gilia congesta*. POLYGONACEAE: *Eriogonum fasciculatum*, *Eriogonum umbellatum* var. *nevadense*. PORTULACACEAE: *Calyptridium umbellatum*. RHAMNACEAE: *Ceanothus parviflorus*. ROSACEAE: *Chamaebatia foliolosa*; *Horkelia fusca* spp. *parviflora*, *Horkelia tridentata*; *Potentilla crinita*; *Rubus leucodermis*.

*Biology*: The nesting habits of this species were described by Hicks (1929a). Nests consisted of between one and four cells made with trichomes of *Lepidospartum squamatum* (Asteraceae), and were located at the bottom of abandoned tunnels (22–65 mm in length and 5–7 mm in diameter) of coleopterans found inside old yucca flower stalks (Agavaceae: *Yucca* sp.) and oak stumps (Fagaceae: *Quercus* sp.). An unidentified Meloid parasite was recorded from a trap nest in Carnelian Bay, California (Parker & Bohart, 1968).

*Comments*: *Anthidium mormonum* is quite variable across its range, as might be suggested by the numerous synonyms. Males from California and southern Nevada to British Columbia possess a brush of short, stout, simple, brownish hairs beneath the long plumose pubescence. Specimens from this region tend to be smaller and have the lateral lobe of T7 narrower than material to the east. Specimens from Arizona, New Mexico, and Wyoming sometimes have an S8 with apical process more weakly bifid and the T7 with outer margin more curved than in specimens from California. Throughout most of its range, *A. mormonum* is extensively maculate. In material from British Columbia (including the type of *A. wallisi*), female markings are much reduced: absent on mandible, clypeus, dorsum of mesosoma, mesepisternum, femora; tibiae with longitudinal stripes, T1–T5 with thin emarginate markings, T6 with two oval maculae. Some material from Oregon and Washington is similarly dark, although sometimes with lateral marks on the clypeus. No structural differences are evident. The type of *A. pondreum* could not be examined.

#### **ANTHIDIUM MULTISPINOSUM SP. NOV.**

FEMALE, FIGS 29, 99; MAP, FIG. 579

*Diagnosis*: This species of northern Mexico is only known from the female, which is easily separated

from all other NW *Anthidium* by the T6 with distinctive set of four spines on the distal margin (Fig. 29) and the mid tibia with well-developed apical spine on the outer surface. Some South American species, such as *A. espinosai* and related species, also possess spines on the distal margin of T6, but they differ in the shape of the tergum, sculpturing of the terga, shape of the clypeus, and body colour.

*Description: Female.* Body length 10.5 mm; forewing length 7.5 mm. *Structure.* Clypeus prominently convex, projected about 0.5× width of compound eye in profile, distal margin thin, straight, two lateralmost tubercles distinctly projected (Fig. 99); mandible with five teeth; labrum gently elevated basally, not tuberculate, preapical projections large, distinctly curved upwards; F1 1.3× longer than broad, shorter (~0.6×) than combined lengths of F2 and F3. Tibial carina absent. T6 transversely depressed on disc, with strongly projecting lateral angle and four spinose projections on distal margin, preapical carina absent, depressed apical rim absent (Fig. 29). *Coloration.* Black, except reddish brown on tarsi, disc of T6, sides of S1, and centre of S6; yellow maculations as follows: small oval spot (0.5–1.0× OD) laterally on vertex, anterolateral margin of tegula, laterally on T1, and medially interrupted bands on T2–T5, each band laterally deeply notched on anterior margin, except weakly separated and laterally reduced on T5 (thus appearing with two large submedian spots). Wings hyaline; veins and stigma mostly dark brown. *Pubescence.* Whitish, except brownish to light ferruginous hairs on inner surfaces of hind tarsi and centre of S3–S6. Outer surfaces of fore and middle basitarsi sparsely covered by tomentum (integument barely visible among hairs). *Sculpturing.* Propodeal triangle dull, finely lineolate to imbricate. T1–T5 with weakly elevated discal areas, finely lineolate to imbricate, weakly shiny between punctures (1–3× PW); depressed marginal zones with denser punctures than on discs (1–3× PW), medially absent on T1; distal margins dull, narrow (1–2× PW), except on T1 (laterally about as broad as depressed marginal zone).

*Holotype:* ♀, MEXICO: Durango, Mapimí Reserva Biósfera, Presón los Tariques, 26°44'16"N, 103°44'59"W, 1172 m a.s.l., 15/03/1994, 15.55, R. López R. 175, 289 (UNAM).

*Distribution:* MEXICO: Durango (1200 m a.s.l.). Known from a single specimen from the southern Chihuahuan Desert (Fig. 579).

*Phenology:* March.

*Etymology:* The specific epithet refers to the distinctive spines on T6 and the middle tibiae.

*Comments:* The following parts are missing from the right side of the holotype: flagellum, except for F1; foreleg, including coxa; middle tarsi, including basitarsus; and hindleg, except for coxa.

#### *ANTHIDIUM NEFFI* SP. NOV.

FEMALE, FIGS 100, 178

*Diagnosis:* This species is only known from the female holotype, which can be easily separated from all other South American *Anthidium* by the T6 distinctly flat to nearly concave in profile, narrowed apically, with lateral margins concave, and distal margin straight between gently curved submedian spines (Fig. 178).

*Description: Female.* Body length 11.8 mm; forewing length 9.2 mm. *Structure.* Clypeus gently convex, projected about 0.4× width of compound eye in profile, distal margin thick, broader medially, sublateral tubercles not distinctly projected (Fig. 100); mandible with seven teeth; labrum without basal protuberances, preapical projections small, indicated by elevated border on lateral margin of furrow; F1 about twice as long as broad, slightly shorter (0.9×) than combined lengths of F2 and F3. Tibial carina absent. T6 distinctly flat to nearly concave in profile, without lateral spine, lateral margins concave, distal margin straight between gently curved submedian spines, depressed apical rim absent (Fig. 178). *Coloration.* Black, except: outer surface of mandible yellowish, except medially; ferruginous on antenna, except last flagellar segment, pronotal lobe, tegula, and legs, except coxae and trochanters; cream as follows: small oval spot laterally on vertex and T1–T5 with medially interrupted bands, closer on apical terga, laterally slightly notched on posterior margin of T1–T3. Wings light orange basally, brownish distally, with greenish or coppery reflections; veins ferruginous basally (including stigma and prestigma), dark brown distally. *Pubescence.* Whitish, except ferruginous hairs on vertex, pronotal lobe, scutum, axilla, scutellum, and legs, except coxae and trochanters; dark brown to black hairs on sterna, depressed marginal zones of T1–T4, and remaining terga. Fore basitarsus with outer surface densely covered with tomentum (integument not visible among hairs). Outer surfaces of hind tibia and basitarsus sparsely covered with distinctly shorter and thicker hairs than those on anterior margin. *Sculpturing.* Propodeal triangle weakly shiny, lineolate to imbricate. T1–T5 with weakly elevated discal areas, weakly shiny, finely lineolate, sparsely punctate ( $\geq 3.0\times$  PW); depressed marginal zones more densely punctate than on discs (2–3× PW);



distal margins about one-third of depressed marginal zone, little differentiated from it.

*Holotype*: ♀, ARGENTINA: // 33242 // Neuquén Pic-hunches: Las Lajas, 17 km SE, 924 m 38.612°S, 70.351°W, J.L. Neff, 18-xi-2008 // On flowers of *Adesmia adriani* (Fabaceae) (MACN).

*Etymology*: This species is dedicated to Dr John L. Neff, friend and colleague, who has contributed much of the South American material we have studied, including the species described here.

*Distribution*: ARGENTINA: Neuquén (900 m a.s.l.), in the Patagonian steppe ecoregion.

*Phenology*: November.

*Floral records*: FABACEAE: *Adesmia adriani*.

*ANTHIDIUM NIGERRIMUM* SCHROTTKY, 1910  
FEMALE, FIGS 101, 179; MALE, FIGS 253, 379,  
456, 533

*Anthidium nigerrimum* Schrottky, 1910: 269 (lecto-type: MZUSP; ♀, Cuzco, Peru); Urban, 2001a: 15 (type designation).

*Diagnosis*: This species is most similar to *A. atacamense* sp. nov. and *A. espinosai* (see diagnoses). It can be separated from those species by the female T6 gently convex basally, flattened to weakly concave distally in profile view, without distinct lateral spine, and with submedian and median spines on distal margin (Fig. 179). In addition, F1 is more elongate and slightly longer than the combined lengths of F2 and F3; the hairs on the outer surfaces of the hind tibia and basitarsus are not distinctly shorter and thicker than those on the anterior margin; and the distal margins of the terga are much narrower (1–2× PW) than in those species. The male can be separated from those species by the S4 without an apical hair brush and S6 with distal margin reflexed, except medially (Fig. 379).

*Description*: *Female*. Body length 10.0–11.5 mm; forewing length 8.6–9.2 mm. *Structure*. Clypeus prominently convex, projected about 0.6× width of compound eye in profile, distal margin thin, gently tuberculate (Fig. 101); mandible with seven teeth; labrum without basal protuberances, preapical projections small, tuberculiform; F1 2.5× longer than broad, about 1.3× longer than combined lengths of F2 and F3. Tibial carina absent. T6 basally gently convex, flattened to weakly concave distally in profile

view, somewhat elevated along midline, distal margin broadly rounded, without distinct lateral angle, submedian and median spines distinct, depressed apical rim absent (Fig. 179). *Coloration*. Black, except ferruginous on antenna (usually black), tegula (usually black), apices of femora, tibiae, and tarsi; cream as follows: small oval spot laterally on vertex, T1–T4 with small lateral bands or spots (usually reduced or absent, except on T1), and T5 with medially interrupted or deeply notched submedian band. Wings brownish, with weak greenish, coppery, bluish, or violet reflections; veins and stigma dark brown. *Pubescence*. Black with ferruginous hairs on antenna, apices of femora, tibiae and tarsi; whitish hairs on mesosoma (excluding legs) and disc of T1. *Sculpturing*. Supraclypeal area impunctate along midline. Propodeal triangle dull to weakly shiny, lineolate to imbricate. T1–T5 with weakly elevated discal areas, glossy, sparsely punctate (2.0–3.0× PW); depressed marginal zones more densely punctate than on discs (1–2× PW); distal margins smooth, narrow (1–2× PW).

*Male*. Body length 13.5 mm; forewing length 10.3 mm. *Structure*. Labrum with preapical tubercles barely indicated; F1 2.3× longer than broad, about as long as combined lengths of F2 and F3. Lateral spine of T6 strongly curved, distinctly longer and stouter than lateral lobe and median spine of T7; T7 narrowed apically, lateral lobe spiniform, close, ventral to median spine (Fig. 253); S4 without apical brush, distal margin straight or nearly straight; S6, in ventral view, with basal margin strongly convex, distal margin somewhat truncated, distal margin reflexed, except medially (Fig. 379); S7 hemisternite as in Figure 456; S8 with distal margin medially projecting in small curved apex (Fig. 533). *Genitalia*: gonostylus robust, 3.0× longer than broad, distinctly narrowed basally; volsella about half of gonostylar length, somewhat obliquely truncate in profile, dorsally projecting into lobe; penis valve about as long as gonostylus, apex pointed, blade-like, dorsoapical patch of hairs reduced or absent, medial projection large, distinct. *Coloration*. As in female, except yellow or cream on outer surface of mandible, clypeus, and inferior paraocular area. *Pubescence*. Black, except face, vertex, dorsum of mesosoma, mesepisternum, and posterior surface of fore femur with whitish hairs. *Sculpturing*. Terga slightly more densely punctate than in female.

*Distribution*: PERU: Ancash, Lima, Cusco, Puno. BOLIVIA: Potosí. CHILE: Arica and Parinacota (3500–4400 m a.s.l.). Recorded from the Central Andean dry puna and Central Andean wet puna.

*Phenology*: January, February, April, July, October.

*Floral records:* FABACEAE: *Astragalus bustillosii*.  
LOASACEAE: *Caiophora rahmeri*.

*Comments:* Both male and female specimens sometimes have ferruginous antenna and tegula. In the female specimen from Bolivia, the distal margin of T6 is rather pointed, not broadly rounded, as in other specimens.

*ANTHIDIUM OBLONGATUM* (ILLIGER, 1806)

FEMALE, FIGS 102, 180; MALE, FIGS 254, 380, 457, 534; MAP, FIG. 580

*Anthophora oblongata* Illiger, 1806: 118 (new name for *Apis manicata* Linnaeus, 1758 *sensu* Panzer, 1798: 55; fig. 10)

*Diagnosis:* This is the only species of the OW subgenus *Proanthidium* introduced to the Americas; in addition to the pronotal lobe and scutellum of both sexes lamellate, the female can be recognized by the T6 strongly concave (Fig. 180) and distinctive mandible with between nine and 12 teeth, the upper teeth being smaller and often reduced, thus the mandibular margin appearing concave between the large middle and basal teeth. The male is recognized by the T6 with median apical projection and the T7 without a median spine (Fig. 254).

*Description: Female.* Body length 8.0–10.0 mm; forewing length 6.9–7.7 mm. *Structure.* Clypeus weakly convex, projected about 0.3× width of compound eye, distal margin straight or nearly straight, two lateral-most tubercles not distinctly projected (Fig. 102); mandible with between nine and 12 teeth, upper teeth small, often reduced, thus mandibular margin appearing concave between large middle and basal teeth; labrum gently elevated basally, not tuberculate, with single, curved, preapical median projection; F1 1.4× longer than broad, slightly shorter (~0.8×) than combined lengths of F2 and F3. Pronotal lobe strongly lamellate; scutellum, next to axilla, produced to tooth or angle. Tibial carina absent. T6 broadly rounded in dorsal view, strongly concave in profile, preapical carina minutely crenulate, in nearly right angle to dorsum of tergum (Fig. 180). *Coloration.* Black, except yellow as follows: outer surface of mandible, clypeus (sometimes with pair of small, elongate, basal spots, and distal margin dark brown), lower paraocular area, medially interrupted band on vertex (usually broadest laterally), pronotal lobe, anterior half of tegula, axilla (sometimes reduced), distal half of scutellum, except medially (sometimes reduced or absent), and terga with bands broadly interrupted medially, closer on apical terga; yellowish orange to ferruginous on most of legs. *Pubescence.* Yellowish to

light ferruginous, except pale hairs on gena, sides of mesosoma, and sides of sternal scopa. *Sculpturing.* Propodeal triangle shiny, nearly smooth. T1–T5 with weakly elevated discal areas, shiny, nearly smooth between coarse, dense punctures ( $\leq 1\times$  PW); depressed marginal zones with punctures smaller, denser than on discs; distal margins shiny, narrow ( $1\text{--}2\times$  PW), nearly absent on T5.

*Male.* Body length 8.5–13.1 mm; forewing length 7.1–9.2 mm. *Structure.* F1 1.4× longer than broad, shorter (0.7×) than combined lengths of F2 and F3. T6 with midapical projection on distal margin, lateral spine straight; T7 with median spine absent, lateral lobe with outer margin broadly convex, inner margin straight (Fig. 254); S4 with distal margin weakly concave medially, without distinct apical brush, at most with row of stout, long, reddish hairs, hardly seen among branched, normal sternal hairs; S6, in ventral view, with straight basal margin, broadly rounded distally, slightly projecting medially (Fig. 380); S7 hemisternite elongate (Fig. 457); S8 with short, subquadrate apical process, about one-third width of distal margin basally (Fig. 534). Genitalia: gonostylus slender in ventral view, 3.2× longer than broad, distally tapering, curving in profile view; volsella small, about one-third of gonostylar length, rectangular in profile, laterally curved in ventral view; penis valve about as long as gonostylus, dorsoapical patch of hairs distinct, medial projection large, distinct. *Coloration.* As in female, except yellow on inferior margins of femora and hind tibia (sometimes absent). *Sculpturing.* Terga shinier, with broader distal margins than in female.

*Distribution:* Eastern USA: from New Hampshire to Virginia and Illinois. Adjacent CANADA: Ontario (0–500 m a.s.l. in North America). This invasive species, apparently first accidentally introduced into north-eastern USA, is now found throughout that region to Illinois and southern Canada (Hoebeker & Wheeler, 1999; Miller *et al.*, 2002; Romankova, 2003; Tonietto & Ascher, 2008; Maier, 2009; Fig. 580). Its expansion has not been as rapid as *A. manicatum*, but future expansion is plausible.

*Phenology:* May–September; majority of records (89%) from June through August.

*Floral records:* CRASSULACEAE: *Sedum spectabile*.  
FABACEAE: *Medicago sativa*; *Onobrychis* sp.

*Comments:* The several names synonymized under this species are found in Warncke (1980) and Schwarz *et al.* (1996).

*ANTHIDIUM PAITENSE* COCKERELL, 1926

MALE, FIGS 255, 314, 381, 458, 535

*Anthidium paitense* Cockerell, 1926a: 217 (holotype: AMNH; ♂, Paita, Piura, Peru).

**Diagnosis:** This species is only known from the male (but see comments below). It is easily separated from all other NW *Anthidium* by the following combination of characters: tibial carina present; T7 with lateral lobe elongate and apically rounded (Fig. 255); S4 with apical hair brush reddish brown (Fig. 314); and S6 laterally with spine or angle short, ventrolaterally projected, and median lobe short, apically rounded (Fig. 381).

**Description:** *Male.* Body length 12.6–13.8 mm; forewing length 9.2–9.5 mm. **Structure.** Labrum without basal protuberances, preapical projections reduced, tuberculiform; F1 about 1.3× longer than broad, shorter (0.6×) than combined lengths of F2 and F3. Tibial carina present. Lateral spine of T6 gently curved, about as long as median spine of T7; lateral lobe of T7 elongate, apically rounded, about 1.5× broader than distance between inner margin and median spine, apically slightly diverging from midline (Fig. 255); S4 with apical brush of long reddish brown hairs on one-fifth of straight distal margin (Fig. 314); S6, in ventral view, with basal margin gently convex, laterally with short, ventrolaterally projected spine or angle, distal margin medially projected into short, apically rounded median lobe (Fig. 381); S7 hemisternite apically truncate (Fig. 458); S8 with short, straight, simple apical process, basally broad, about one-third width of distal margin (Fig. 535). Genitalia: gonostylus robust, 2.5× longer than broad; volsella large, about half of gonostylar length, apex narrow, ventrally curved; penis valve about two-thirds of gonostylar length, apex long, narrow, pointed, blade-like, dorsoapical patch of hairs absent, medial projection large, distinct. **Coloration.** Dark brown to black, except: ferruginous on distitarsi; yellow as follows: outer surface of mandible, clypeus, inferior paraocular area, anterior surface of scape distally (sometimes absent), rounded to oval spot laterally on vertex, pronotal lobe, tegula except on disc, scutum with short band on anterolateral and lateral margins, axilla, distal margin of scutellum, except medially, superior margins of femora, with small apical spot (usually absent on fore femur), outer surfaces of tibiae and basitarsi, T1–T5 each with four large spots, and T6 with two large submedian spots. Wings hyaline, slightly brownish; veins and stigma dark brown. **Pubescence.** Whitish, except yellowish to ferruginous hairs on vertex, dorsum of mesosoma, and terga. **Sculpturing.** Propodeal triangle dull to weakly shiny,

finely imbricate. T1–T5 with weakly elevated discal areas, weakly shiny, weakly imbricate between punctures (2–4× PW); depressed marginal zones with punctures slightly denser than on discs (1–2× PW); distal margins broad, about one-third width of depressed marginal zone, little differentiated from it, broadest on T5.

**Distribution:** PERU: Ancash, La Libertad, Lima, Piura (0–1600 m a.s.l.). Found in the Sechura Desert ecoregion.

**Phenology:** March, May, July, August.

**Comments:** Cockerell described *A. paitense* from the male. He did not mention the number of specimens he examined, but one specimen with a ‘type’ label is at the AMNH, whereas another one with a ‘cotype’ label is at the USMN. These specimens are the holotype and paratype, not syntypes as indicated by Urban & Moure (2007).

This species is presently known only from the male, but we examined four females from Peru, two of them from Santa Rosa de Quives and two from San Bartolomé, presumably collected while flying along with a male, as indicated in a handwritten additional label. These females are morphologically indistinguishable from that of *A. deceptum*, suggesting a misassociation of sexes or that females of both species are in fact morphologically very similar, such as those of *A. sanguinicaudum* and *A. macushi* sp. nov. However, interspecific cross mating is also possible, and has been observed in other bees (Cooper, 1993). Thus, the sex associations in *A. deceptum* and *A. paitense* need to be confirmed. The complete label data for the two male specimens of *A. paitense* collected with those four females, all deposited in the AMNH, are as follows: ‘PERU: Lima Dept. Sta. Rosa de Quives, near Yangas. 1100 m. V-28–29-96. J.G. Rozen, A. Ugarte, // *Anthidium* (A.) *paitense* Cockerell, det. J.S. Ascher’ and ‘PERU: Lima Dept. San Bartolomé, V-10–96. J.G. Rozen, A. Ugarte, M. Laime // *Anthidium* sp. 5. ♀, Det. A.H. Smith-Pardo // *Anthidium* (A.) *paitense* Cockerell, det. J.S. Ascher’.

*ANTHIDIUM PALLIDICLYPEUM* JAYCOX, 1963

FEMALE, FIGS 103, 181; MALE, FIGS 256, 315, 382, 459, 536; MAP, FIG. 580

*Anthidium pallidiclypeum* Jaycox, 1963: 267 (holotype: CAS 17282; ♂, San Bernardino Mts, California, USA).

**Diagnosis:** The female of this species resembles that of *A. edwardsii* and *A. placitum* in the clypeus with distal margin medially emarginate, but it can be



easily separated by the more prominently convex clypeus, with the distal margin not strongly projected sublaterally (Fig. 103). The male is unique in the clubbed end of the bifid apical process of S8 (Fig. 536); it can also be recognized by the combination of the shape of the lateral lobe of T7 (Fig. 256), S4 with apical hair brush reddish brown (Fig. 315), and S6 with lateral lobe reduced to nearly absent (Fig. 382).

**Description: Female.** Body length 9.2–13.5 mm; forewing length 6.9–8.8 mm. **Structure.** Clypeus weakly convex, projected about 0.3× width of compound eye in profile, distal margin weakly concave to nearly straight, two lateralmost tubercles usually not strongly projected, as in *A. placitum* (Fig. 103); mandible with five or six teeth; labrum gently elevated basally, preapical projections large, distinctly curved upwards; F1 1.7× longer than broad, slightly shorter (~0.7×) than combined lengths of F2 and F3. Tibial carina absent. T6 straight or nearly straight in profile, without distinct lateral spine, depressed apical rim distinctly projecting on slightly more than median half of nearly truncate distal margin (Fig. 181). **Coloration.** Dark brown to black, except: light reddish brown on tarsi; yellow as follows: outer surface of mandible, clypeus, except distal margin and usually two small, basal spots, inferior paraocular area, medially interrupted band on vertex (sometimes reduced to rounded or oval spots behind compound eye), pronotal lobe, anterior and posterior margins of tegula, anterolateral and lateral margins of scutum with continuous broad band (usually reduced to thin lateral band or completely absent), axilla (sometimes reduced or absent), distal margin of scutellum, except medially, ventral surfaces of fore and hind coxae (usually absent), superior margins of femora with small apical spot, inferior margins of femora, except basally (often reduced on hind femur), outer surfaces of fore and middle tibiae and posterior margin of hind tibia with broad band (sometimes reduced or covering entire surface), basitarsi, and terga with medially interrupted bands, laterally notched on anterior margin (T1 usually with four spots). Wings hyaline, slightly brownish; veins and stigma mostly dark brown. **Pubescence.** Whitish to light ferruginous, slightly darker on vertex, scutum, axilla, scutellum, inner surfaces of tarsi, and S6. Outer surfaces of fore and middle basitarsi sparsely covered by tomentum (integument barely visible among hairs). **Sculpturing.** Propodeal triangle weakly shiny, finely lineolate to imbricate. T1–T5 with weakly elevated discal areas, dull or weakly shiny between punctures (2–3× PW); depressed marginal zones with fine, dense punctures ( $\leq 1.0\times$  PW), sparser on T5 (2–3× PW); distal margins dull, narrow (1–2× PW), broadest on T1.

**Male.** Body length 10.0–12.3 mm; forewing length 7.1–9.2 mm. **Structure.** F1 1.5× longer than broad, shorter (0.6×) than combined lengths of F2 and F3. Lateral spine of T6 straight or nearly straight, about as long as median spine of T7; lateral lobe of T7 apically rounded, 1.3–1.5× wider than distance between inner margin and median spine (Fig. 256); S4 with light-reddish brown apical hair brush on median one-third of straight distal margin, often hardly seen among sternal hairs (Fig. 315); S6, in ventral view, with gently convex to nearly straight basal margin, laterally angulated, not projecting into lobe, median lobe subrectangular, broader than long (Fig. 382); S7 hemisternite distally truncate (Fig. 459); S8 with long, narrow apical process, deeply bifid apically, with ventrally bent (~100°) digitiform to capitate lobes (Fig. 536). Genitalia: gonostylus robust, 2.7× longer than broad, broader near apex, nearly parallel-sided in profile; volsella small, about one-third of gonostylar length, obliquely truncate, ventrally pointed in profile; penis valve about half of gonostylar length, dorsoapical patch of hairs present, medial projection small. **Coloration.** As in female, except yellow on hind trochanter, sides of S2–S5 (usually absent), and T7 (sometimes reduced or absent).

**Distribution:** MEXICO: Baja California. USA: California (South Coast Range, southern California mountains), mountainous areas of the Mojave Desert in California and southern Nevada (100–2100 m a.s.l.). Restricted to the California chaparral and woodlands (45% of records), Mojave Desert (53%), and southeastern portion of the Great Basin shrub steppe ecoregions (Fig. 580).

**Phenology:** Late April–early July. The period from the last half of May and first half of June account for 71% of records.

**Floral records:** ASTERACEAE: *Cirsium* sp.; *Encelia virginensis*. BORAGINACEAE: *Phacelia argentea*. CACTACEAE: *Opuntia* sp. FABACEAE: *Dalea* sp.; *Lotus procumbens*, *Lotus scoparius*; *Psoralea fremontii*; *Trifolium variegatum*. LAMIACEAE: *Salazaria mexicana*; *Salvia dorrii*; *Trichostema lanatum*. PLANTAGINACEAE: *Collinsia concolor*, *C. heterophylla*; *Keckiella antirrhinoides*. POLYGONACEAE: *Eriogonum fasciculatum*. RANUNCULACEAE: *Delphinium parishii*, *Delphinium parryi*. RHAMNACEAE: *Ceanothus* sp.

#### *ANTHIDIUM PALLIVENTRE* CRESSON, 1878

FEMALE, FIGS 21, 104, 182; MALE, FIGS 257, 316, 383, 460, 537; MAP, FIG. 581

*Anthidium palliventre* Cresson, 1878: 114 (lectotype: ANSP 2387; ♀, California, USA); Cresson, 1916: 127 (type designation).

*Anthidium pallidiventre* Dalla Torre, 1896: 468 (emendation).

*Anthidium californicum* Cresson, 1879: 206 (lectotype: ANSP 2390; ♂, California, USA); Cresson, 1916: 114 (type designation); Michener 1951: 1141 (synonymy with *palliventre*).

*Anthidium palliventre vanduzeei* Cockerell, 1937b: 150 (holotype: CAS 4652; ♂, Cuyler's Cove, San Miguel Island, California, USA); Grigarick & Stange, 1968: 28 (synonymy with *palliventre*).

**Diagnosis:** The female of this species is easily separated from all other North American *Anthidium* by the fore basitarsus with a distinct fringe of long hairs ( $\geq 2\times$  basitarsal width) along the posterior margin (Fig. 21). The male can be recognized by the following combination of characters: T7 with lateral lobe usually apically curved (Fig. 257); S6 with lateral lobe acute and median lobe bidentate (Fig. 383); and S8 apically bifid, without a long, slender, apical process (Fig. 537).

**Description: Female.** Body length 8.5–10.6 mm; forewing length 5.8–7.1 mm. **Structure.** Clypeus prominently convex, projected about  $0.5\times$  width of compound eye in profile, distal margin weakly concave to nearly straight, two lateralmost tubercles usually strongly projected (Fig. 104); mandible with six teeth; labrum gently elevated basally, preapical projections large, distinctly curved upwards; F1  $1.7\times$  longer than broad, slightly shorter ( $\sim 0.8\times$ ) than combined lengths of F2 and F3. Tibial carina absent. T6 straight or nearly straight in profile, lateral angle distinct, depressed apical rim distinctly projecting on median three-quarters of nearly truncate distal margin (Fig. 182). **Coloration.** Dark brown to black, except: light-reddish brown on tarsi; yellow as follows: rounded to oval spot laterally on vertex (sometimes reduced or absent), anterior margin of tegula, and terga with medially interrupted bands, laterally notched on anterior margin (T1 usually with four spots). Wings hyaline, slightly brownish; veins and stigma mostly dark brown. **Pubescence.** Whitish, except ferruginous on vertex, pronotal lobe, scutum, axilla, and scutellum; dark brown on inner surfaces of tarsi and centre of S2–S6. Outer surfaces of basitarsi densely covered by tomentum (integument not visible among hairs), sparser on hind basitarsus. **Sculpturing.** Propodeal triangle dull to weakly shiny, finely lineolate to imbricate. T1–T5 with weakly elevated discal areas, dull or weakly shiny between punctures ( $2\text{--}3\times$  PW); depressed marginal zones with fine, smaller, denser punctures ( $\leq 1.0\times$  PW) than those on discs; distal margins dull, narrow ( $1\text{--}2\times$  PW), broadest on T1.

**Male.** Body length 10.0–15.4 mm; forewing length 7.1–8.5 mm. **Structure.** F1  $1.9\times$  longer than broad,

shorter ( $0.7\times$ ) than combined lengths of F2 and F3. Lateral spine of T6 straight or nearly straight, about as long as median spine of T7; lateral lobe of T7 tapering distally, usually curved, about  $1.3\times$  wider than distance between inner margin and median spine (Fig. 257); S4 with small, dark-brown apical hair brush on median one-quarter of gently convex distal margin (Fig. 316); S6, in ventral view, with gently convex to nearly straight basal margin, lateral lobe acute, ventrally directed, median lobe bispinose (Fig. 383); S7 hemisternite distally truncate (Fig. 460); S8 with bifid apical process not attached to disc by long, narrow stalk, pointed lobes slightly ventrally bent in profile (Fig. 537). **Genitalia:** gonostylus robust,  $2.5\times$  longer than broad, broadest near apex; volsella small, about one-third of gonostylar length, broader basally; penis valve about half of gonostylar length, dorsoapical patch of hairs present, medial projection small. **Coloration.** As in female, except yellow on outer surface of mandible, clypeus, inferior paraocular area, outer surfaces of fore and middle tibiae with small apical spot (usually absent), basitarsi, and T6 with two submedian spots. **Sculpturing.** Terga slightly shinier, with broader distal margins than in female.

**Distribution:** USA: coastal dunes, from southern California to northern Oregon (0–200 m a.s.l.) (Fig. 581). Also reported from the Owens Valley, eastern California (Grigarick & Stange, 1968), but these records from the 1930s have not been confirmed, nor have they been repeated. They are suspect.

**Phenology:** April–late September; one record from 24 October; majority of records (85%) from May through July.

**Floral records:** ASTERACEAE: *Leontodon* sp.; *Solidago spathulata*. BORAGINACEAE: *Phacelia distans*, *Phacelia ramosissima*. BRASSICACEAE: *Cakile maritima*. CRASSULACEAE: *Dudleya* sp. FABACEAE: *Lathyrus littoralis*; *Lotus eriophorus*, *Lotus heermannii*; *Lupinus arboreus*; *Trifolium* sp. NYCTAGINACEAE: *Abronia maritima*. POLEMONIACEAE: *Navarretia squarrosa*. POLYGONACEAE: *Eriogonum latifolium*; *Polygonum paronychia*. ROSACEAE: *Horkelia* sp.; *Rubus* sp.

**Biology:** This species appears restricted to sand dune areas. Unlike most *Anthidium*, the nesting biologies of which are known, it excavates its own nest in the sand using the long fringe of hairs along the posterior margin of the fore basitarsus (Hicks, 1928). Males are

territorial at host plants preferred by females (Villalobos & Shelly, 1991).

*ANTHIDIUM PALMARUM* COCKERELL, 1904

FEMALE, FIGS 105, 183; MALE, FIGS 258, 317, 384, 461, 538; MAP, FIG. 581

*Anthidium palmarum* Cockerell, 1904b: 59 (holotype: AMNH; ♂, Palm Springs, California, USA).

*Anthidium palmarum micheneri* Schwarz, 1957: 132 (holotype: AMNH; ♂, Quemado, Texas, USA); Grigarick & Stange, 1968: 29 (synonymy with *palmarum*).

**Diagnosis:** The female of this species is easily separated from all North American *Anthidium*, except *A. schwarzi* sp. nov., by the T6 distinctly convex, with a broad submedian lobe on the distal margin (Fig. 183). T6 lacks the distinct lateral tooth or spine of *A. schwarzi* sp. nov., and the mandible, clypeus, and inferior paraocular area are mostly yellow (Fig. 105); such areas are black in *A. schwarzi* sp. nov. The male is recognized by the T7 with lateral lobe narrow, usually apically curved (Fig. 258), S4 with apical hair brush distinctively broad on the broadly concave distal margin (Fig. 317), and the S6 with lateral lobe low and median lobe short, weakly emarginate (Fig. 384). Also, the tegula, femora, and tibiae are usually light-reddish brown in both sexes.

**Description:** *Female.* Body length 7.2–9.4 mm; forewing length 5.1–6.6 mm. *Structure.* Clypeus prominently convex, projected about 0.4× width of compound eye in profile, distal margin nearly straight, two lateralmost tubercles usually strongly projected (Fig. 105); mandible with four or five teeth; labrum without basal protuberances, preapical projections large, distinctly curved upwards; F1 1.9× longer than broad, slightly shorter (~0.7×) than combined lengths of F2 and F3. Tibial carina absent. T6 distinctly convex in profile, without distinct lateral angle or spine, depressed apical rim visible across entire distal margin, laterally projecting into distinct submedian lobe (Fig. 183), sometimes weakly projected. *Coloration.* Black, except light-reddish brown on antennal flagellum (sometimes dark brown), tegula (sometimes yellow, except on disc), and legs excluding, coxae, trochanters, and bases of femora; yellow as follows: outer surface of mandible, distal two-thirds of clypeus (sometimes broadly interrupted medially), inferior paraocular area with small spot (usually absent), rounded to oval spot laterally on vertex, distal half of scutellum, except medially, basitarsi (usually absent), and terga with medially interrupted bands, laterally notched on anterior margin (T1 usually with four spots). Wings hyaline, slightly

yellowish; veins and stigma mostly dark brown. *Pubescence.* Whitish, except light ferruginous hairs on vertex, pronotal lobe, scutum, axilla, and scutellum, inner surfaces of tarsi, and centre of S6. Outer surfaces of basitarsi densely covered by tomentum (integument not visible among hairs). *Sculpturing.* Propodeal triangle weakly shiny, weakly lineolate to imbricate. T1–T5 with weakly elevated discal areas, dull or weakly shiny, weakly lineolate to imbricate between punctures (2–3× PW), T6 smoothest and shiniest; depressed marginal zones with slightly denser punctures than on discs (1–2× PW); distal margins dull, narrow (1–2× PW), little differentiated from rest of depressed marginal zone, broadest on T1.

*Male.* Body length 8.8–13.1 mm; forewing length 5.4–8.5 mm. *Structure.* Labrum with preapical projections longer than in female; F1 1.6× longer than broad, shorter (0.7×) than combined lengths of F2 and F3. Lateral spine of T6 straight or nearly straight, about as long as median spine of T7; lateral lobe of T7 tapering distally, curved, about 1.3× wider than distance between inner margin and median spine (Fig. 258); S4 with apical brush of long, black hairs on deeply concave median half of distal margin (Fig. 317); S6, in ventral view, with nearly straight basal margin, laterally rounded, not projecting into distinct acute lobe, median lobe short, much broader than long, weakly concave distally (Fig. 384); S7 hemisternite somewhat pointed apically (Fig. 461); S8 with weakly bifid apical process, about 0.4× width of distal margin basally, gently curved in profile (Fig. 538). Genitalia: gonostylus robust, 3.0× longer than broad, broadest near apex; volsella small, about one-third of gonostylar length, subtriangular in profile view; penis valve about half of gonostylar length, dorsoapical patch of hairs present, medial projection small. *Coloration.* As in female, except yellow as follows: clypeus, excepting pair of small, dark, basal spots (usually absent), inferior paraocular area, small spots (often reduced or absent) on ventral surfaces of coxae, apices of femora, outer surfaces of tibiae, basitarsi, T2–T5 usually with four spots, and T6, with two submedian spots. *Sculpturing.* Terga with finer punctures and broader distal margins than in female.

**Distribution:** USA: southern California, Arizona, New Mexico, western Texas, southern Nevada, southern Utah. Adjacent MEXICO: Baja California, Sonora (from –80 to 2400 m a.s.l.; below sea level in Death Valley, California). Predominately in the Mojave, Sonoran, Baja California, and Chihuahuan deserts (74% of records), but ranges north into the southern margin of the San Joaquin Valley, the southern Great Basin, the Arizona Mountain forests, and the Colorado Plateau shrubland ecoregions (Fig. 581).



**Phenology:** February–early July. April and May account for 87% of records.

**Floral records:** ALLIACEAE: *Allium fimbriatum*. ASTERACEAE: *Acamptopappus sphaerocephalus*; *Baileya multiradiata*; *Bebbia juncea*; *Chaenactis stevioides*; *Cirsium* sp.; *Ericameria linearifolia*; *Encelia farinosa*, *Encelia virginensis*; *Haplopappus linearifolius*; *Senecio flaccidus* var. *flaccidus*, *Sericocarpus tortifolius*. BORAGINACEAE: *Amsinckia* sp.; *Cryptantha maritima*; *Nama* sp.; *Phacelia affinis*, *Phacelia ciliata*, *Phacelia cicutaria* var. *hispida*, *Phacelia crenulata*, *Phacelia distans*, *Phacelia fremontii*, *Phacelia heterophylla*, *Phacelia pulchella*, *Phacelia ramosissima*, *Phacelia vallis-mortae*. BRASSICACEAE: *Lepidium montanum*. FABACEAE: *Astragalus lentiginosus*; *Dalea* sp.; *Lotus douglasii*, *Lotus corniculatus*, *Lotus scoparius*; *Psorothamnus arborescens*, *Psorothamnus fremontii*, *Psorothamnus schottii*. LAMIACEAE: *Salazaria mexicana*; *Salvia carduacea*, *Salvia dorrii*. MALVACEAE: *Sphaeralcea ambigua*. ONAGRACEAE: *Oenothera* sp. POLYGONACEAE: *Eriogonum fasciculatum*, *Eriogonum fasciculatum* var. *polifolium*. PLANTAGINACEAE: *Keckiella antirrhinoides*. SOLANACEAE: *Lycium pallidum*.

**Biology:** Nests have been found in burrows of dead floral scapes of *Hesperoyucca whipplei* (Agavaceae) (Hurd, 1979). Males are territorial at host plants preferred by females (Wainwright, 1978).

**Comments:** Females from Baja California, California, and Nevada to Texas, including most of Arizona, have the tibia and tegula largely or entirely red. Specimens from extreme southern Arizona, south-western New Mexico, and Sonora, Mexico, have a black tibia with a longitudinal yellow stripe. These also have the submedian lobe of T6 smaller, farther from the lateral angle. It is conceivable that these specimens represent a distinct species, but differences in the corresponding males are not evident.

#### **ANTHIDIUM PARKERI SP. NOV.**

FEMALE, FIGS 15, 106, 184; MALE, FIGS 259, 385, 462, 539, 572; MAP, FIG. 580

**Diagnosis:** This species is most similar to *A. maculosum* (see above). In addition to the characters indicated in the key and diagnosis of *A. maculosum*, the female of *A. parkeri* sp. nov. can be separated by the clypeus duller, and the scutum and scutellum shinier, with coarser and sparser punctures (especially on the discs) than on *A. maculosum*; the male can also be distinguished by the clypeus with a small medial

denticle on the apical margin, S6 with median lobe apically subtruncate (Fig. 385), and the shapes of S7 (Fig. 462) and S8 (Fig. 539).

**Description (paratypes in parentheses): Female.** Body length mm 12.3 mm (10.0–12.3); forewing length 8.5 mm (8.3–9.7). **Structure.** Compound eyes gently convergent below, nearly parallel-sided; face flat; clypeus with distal margin sinuous (nearly straight) (Fig. 106); mandible elongate, with eight teeth (nine); labrum with basal protuberances separated by about width of protuberance, preapical projections absent; F1 2.5× longer than broad, about as long as combined lengths of F2 and F3 (Fig. 15). Tibial carina present. T6 straight in profile, lateral projection small, preapical carina minutely crenulate, depressed apical rim projecting on median one-third of distal margin (Fig. 184). **Coloration.** Black, except brownish on tarsi; yellow maculations as follows: outer surface of mandible, oval spot (1.0× OD) laterally on vertex (some paratypes with yellow spots of variable size on apicolateral sides of clypeus, inferior paraocular area, and anterior half of tegula), distal third of scutellum, except medially, small spot basally on outer surfaces of fore and middle tibiae (extending along entire surface and also present on hind tibia), T1 laterally, T2 and T3 each with four widely separated spots, except on right side of T3, T4 with medially interrupted band, laterally deeply notched on anterior margin, and T5 with wider, shorter band than on T4, narrowly interrupted medially (some paratypes with four widely separated spots on T1–T3, or with medially interrupted band, as on T4). Wings subhyaline, brownish, veins dark brown. **Pubescence.** Whitish, except brownish hairs on clypeus, supraclypeal area, frons, vertex, inner surfaces of basitarsi, discs of T1–T4, and centre of S6. Clypeus, supraclypeal area, and frons covered with simple, apically curly or hooked hairs. Outer surfaces of basitarsi sparsely covered by tomentum (integument visible among hairs). **Sculpturing.** Clypeus, supraclypeal area, paraocular area, and frons with integument dull, between coarse, sparse punctures (1–2× PW), denser on clypeus. Propodeal triangle dull, finely lineolate. T1–T5 with weakly elevated discal areas, dull or weakly shiny, weakly imbricate between punctures (2–3× PW); depressed marginal zones with punctures smaller, slightly denser (1–2× PW) than on discs; distal margins dull, about one-third width of depressed marginal zone, weakly doubly carinate.

**Male.** Body length 11.5–16.9 mm; forewing length 8.6–11.5 mm. **Structure.** Mandible with distance between second and third teeth about twice as long as distance between first and second teeth; F1 0.9× shorter than combined lengths of F2 and F3. T5 laterally protuberant; T6 with lateral spine strongly

curved, longer than median spine of T7; lateral lobe of T7 subtriangular, arrow-shaped in some specimens (Fig. 259); S4 without apical hair brush, distal margin straight; S5 with distal margin straight or nearly straight; S6, in ventral view, with basal margin straight or nearly straight, lateral spine small, acute, laterally directed, median lobe broader than long, apically truncate (Fig. 385); S7 hemisternite as in Figure 462; S8 with short, simple apical process, basally about one-quarter width of distal margin (Fig. 539). Genitalia: gonostylus robust, 2.0× longer than broad, apex distinctly flat, broad, posteriorly pointed; volsella two-thirds of gonostylus length, digitiform, ventrally curved; penis valve slightly shorter than gonostylus, apex broad, swollen, with short, slender projection distally, dorsoapical patch of hairs absent, medial projection small (Fig. 572). *Coloration*. As in female, except yellow maculations as follows: clypeus, inferior paraocular area, anterior surface of scape, outer surfaces of middle and hind basitarsi (sometimes only distally on hind basitarsus), and T1–T3 each with lateral spots (T2–T4 sometimes with medially interrupted bands, laterally deeply notched on anterior margin); maculations on T4 and T5 usually reduced to submedian bands. *Sculpturing*. Terga with slightly denser punctures on depressed marginal zones than in female.

*Holotype*: ♀, MEXICO: Morelos, Cuernavaca, 8-XI/6-XII-87, F.D. Parker (BBSL).

*Paratypes*: 95 females, 85 males. GUATEMALA: Huehuetenango, 1♀, San Antonio, Huista, Pinalito, 963, 2 Mar 2010, C. Balboa. MEXICO: Chiapas, 7♂, 15♀, El Sumidero, 14 Sep 1974, G. Bohart, W. Hanson; 2♂, 3♀, Tuxtla Gutierrez, 26 Jul 1987, F.D. Parker; Colima, 1♂, Colima, 12 mi SW, 1600 ft, 3 Aug 1971, E.M. Fisher; 2♂, 1♀, Colima, 33 km NW, 800 m a.s.l., 19 Jul 1987, *Cuphea paucipetala*, C.D. Michener; 2♂, Colima, 33 km NW, 800 m a.s.l., 19 Jul 1987, *Cuphea paucipetala*, T.L. Griswold; Guerrero, 1♀, Iguala, 10 km NW, 23 Nov 1985, G. Dieringer; 1♀, Iguala, 15.7 km N, 23 Nov 1985, G. Dieringer; 1♂, Iguala, 18 mi W, 21 Aug 1981, J. Chemsak, A.&M. Michelbacher; 1♂, Iguala, 23 km W, 11–16 Sep 1982, J.A. Powell, J.A. Chemsak; 7♂, 2♀, Las Parotas Atoyac, 10 Sep 1985, O. Morales; 2♂, 2♀, Las Parotas Atoyac, 11 Sep 1985, O. Morales; 1♀, Las Parotas Atoyac, 9 Jul 1985, O. Morales; 1♂, Zapilote Canyon, 8 km S of Mezcala, 550 m a.s.l., 17 Sep 1982, J.A. Powell, J.A. Chemsak; Jalisco, 2♂, 2♀, 0.2 mi from Nayarit st. line, hwy #15, 11 Aug 1963, G.W. Byers; 1♀, Barra de Navidad, 18 mi N, 5 Sep 1975, J.L. Neff; 1♀, Barra de Navidad, 34 km N, 5 Sep 1975, J.L. Neff; 1♂, Chamela, 19 Jul 1953, R. Ayala; 1♀, Chamela, 26–30 Sep 1985, T.L. Griswold, F.D.

Parker; 2♀, Chamela, 30 Sep 1985, J.G. Rozen; 1♀, Chamela, 7 Nov 1986, J.G. Rozen, B.L. Rozen; 1♂, Chamela, 1–8 Oct 1985, T.L. Griswold, F.D. Parker; 1♀, Chamela, Arroyo Chamela, 30 Sep 1985, R. Ayala; 1♀, El Rincon, 6 mi NE, Hwy 80, 3 Aug 1971, E.M. Fisher; 1♀, Estación Biol. Chamela, 1–8 Dec 1988, J.A. Chemsak; 3♂, 1♀, Las Jarillas, 62 km S Puerto Vallarta, 22 Jul 1984, Chemsak, Doyen; 1♀, Mascota, N.L.H. Krauss; 1♀, Mascota, 17 Jul 1989, R. Ayala; 4♂, Mascota, 17 Jul 1989, R.J. McGinley; 1♀, Puerto Vallarta, 21 km S, 18 Jul 1989, G.E. Eickwort; 1♀, Puerto Vallarta, 21 km S, 18 Jul 1989, G.E. Eickwort; 1♂, 1♀, Tequila, 3 mi NW, 19 Jul 1953, *Vitex pyramidata*; 1♀, Tequila, 4.2 km NW, 1310 m a.s.l., 6 Sep 1976, C.D. George, R.R. Snelling; 2♂, Tequila, 7 km N, 6 Sep 1975, J.L. Neff; Mexico, 1♀, El Paso, 19 Jul 1995, D. Furth, G. Chavarria; 1♀, El Paso, 20 Jul 1995, D. Furth, G. Chavarria; 1♀, Ixtapan de la Sal, 20 mi S, 1 Aug 1962; Michoacán, 3♂, 1♀, Arteaga, 33 km NE (hwy 37, K242), 980 m, 10 Nov 1976, E.M. Fisher, P.H. Sullivan; 1♂, Buena Vista, N of Playa Azul, 700 m a.s.l., 2 Nov 1987, T.L. Griswold; 2♂, 1♀, El Cangrejo, 20 km N, La Huacana, 1090 m a.s.l., 30 Oct 1987, T.L. Griswold; 2♂, La Huacana, 20 km NE, 3 Nov 1992, A. Rodriguez, F.A. Noguera; 2♂, La Huacana, 9 km N, 4 Nov 1992, A. Rodriguez, F.A. Noguera; 7♂, La Huacana, 9 km N, 4 Nov 1992, R. Ayala; 1♂, La Huacana, 9 km N, 9 Nov 1992, R. Ayala; 3♀, Los Sabinos, 28 km S Ario de Rosales, 1190 m a.s.l., 29 Oct 1987, T.L. Griswold; 2♀, Tuxpan to San Jose Purua, 5200 ft, 22 Jun 1963, H.A. Scullen, D. Bolinger; Morelos, 2♀, Ajuchitlán, 2.5 km W, 950 m a.s.l., 9 Oct 1996, F.A. Noguera; 2♂, Ajuchitlán, 4 km W, 940 m a.s.l., 19 Nov 1995, A.P. Rodriguez; 2♂, Ajuchitlán, 4 km W, 940 m a.s.l., 19 Nov 1995, M.E. Guardado; 1♂, Autopista México-Cuautla, km 12, 1650 m a.s.l., 22 Dec 1996, O. Yáñez; 2♂, 1♀, Cuernavaca, Nov 1944, N.L.H. Krauss; 1♂, Cuernavaca, 13–14 Nov 1987, F.D. Parker; 4♀, Cuernavaca, 19–21 Nov 1987, F.D. Parker; 3♂, 2♀, Cuernavaca, 8 Nov–6 Dec 1987, F.D. Parker; 1♀, km 19.5, Autopista México-Cuautla, Tepoztlan, 1350 m a.s.l., 16 Nov 1996, O. Yáñez; 1♀, Mascota, 17 Jul 1989, R. Ayala; 1♀, Yautepec, 7 mi NE, 4000 ft, 15 Aug 1962, E. Ordway, Roberts; 1♀, Yautepec, 7 mi SW, 3500 ft, 2 Jul 1961; Nayarit, 2♀, Campostela, 6 km N, 17 Jul 1989, W.E. LaBerge; 2♂, 1♀, Santa Isabella, 9 mi NW, 10 Mar 1972, F. Parker, D. Miller; 2♀, Tepic 15 mi N, 25 Jul 1954, 1♀, Tepic, 10 mi W, 8 Jul 1955, R.R. Snelling; 1♂, Tepic, 16 mi NW, 15 Jul 1986, M. Cazier, W.J. Gertsch, Bradts; 1♂, 3♀, Tepic, 16 mi NW, 19 Jul 1953; Nuevo Leon, 1♀, Saltillo, 34 mi SE, 30 Aug 1974, G. Bohart, W. Hanson; Oaxaca, 1♂, 1♀, Tehuantepec, 12 mi W, 16 Sep 1974, G. Bohart, W. Hanson; Puebla, 2♂, Tepexco, 1 km NE, 31 Oct 1991, R. Ayala; Sinaloa, 5♂, 9♀,

Chupaderos, 9 mi NE, 12 Mar 1972, F. Parker, D. Miller; 1♀, Concordia, 3.5 mi W, 29 Jul 1972, J. & M.A. Chemsak, A. & M. Michelbacher; 1♂, Culiacan, 64 mi SE, 6 Sep 1970, W.J. Hanson, T.L. Whitworth; 1♀, Elota, 10 mi S, 10 Sep 1970, G.E. & R.M. Bohart; 1♀, Mazatlán, 8 Aug 1970, D.W. Davis; 1♂, Mazatlán, 18 mi N, 28 Jul 1972, J. & M.A. Chemsak, A. & M. Michelbacher; 1♀, Mazatlán, 18 mi N, 28 Jul 1972, J. & M.A. Chemsak, A. & M. Michelbacher; 1♂, Mazatlán, 61 mi N, 10 Sep 1970, T.L. Whitworth; 2♀, Rosario, 2 mi SE, 13 Aug 1963 (AMNH, BBSL, CEET, CTMI, CUIC, EMEC, INHS, LACM, UNAM, USNM).

*Distribution:* MEXICO: Sinaloa, Durango to Chiapas; northern Guatemala (0–2100 m a.s.l.; only one record above 1900 m a.s.l.). Most common in the dry forest (64% of records) and pine–oak forest (26%) ecoregions; also occurs in Meseta Central matorral and Tehuacan Valley matorral (Fig. 580).

*Phenology:* March, late June–December.

*Floral records:* LAMIACEAE: *Vitex pyramidata*. LYTHRACEAE: *Cuphea paucipetala*.

*Etymology:* This species is dedicated to Dr Frank Parker, a friend and mentor, who has contributed much of the material we have studied.

*ANTHIDIUM PAROSELAE* COCKERELL, 1898

FEMALE, FIGS 9, 107, 185; MALE, FIGS 260, 386, 463, 540; MAP, FIG. 581

*Anthidium paroselae* Cockerell, 1898: 62 (holotype: SEMC; ♀, Mesilla, New Mexico, USA).

*Diagnosis:* This species resembles *A. rodecki* and *A. sonorensis* in the body pubescence white, clypeus weakly convex, with distal margin straight (Fig. 107), legs mostly yellow, and the terga dull or weakly shiny, finely and sparsely punctate, with complete bands, and distal margins broad. The female can be separated from those species by the mandible with apical tooth pointed, not much broader than remaining teeth (Fig. 9), and the shape of T6 (Fig. 185). The male can be recognized by the shape of T7 (Fig. 260), the S6 with distal margin truncate, not projecting into a median lobe or anteriorly curved (Fig. 386), and the S8 with median lobe short, broad on distal margin (Fig. 540).

*Description: Female.* Body length 7.7–10.0 mm; forewing length 5.7–6.9 mm. *Structure.* Clypeus gently convex, projected about 0.4× width of compound eye in profile, distal margin thin, straight, sublateral tuber-

cles not projected (Fig. 107); mandible with seven teeth, apical tooth pointed, not much broader than remaining teeth (Fig. 9); labrum gently elevated basally, preapical projections absent; F1 1.4× longer than broad, shorter (~0.7×) than combined lengths of F2 and F3. Tibial carina present, sometimes weak. T6 straight or nearly straight in profile, preapical carina translucent, minutely crenulate, depressed apical rim projecting on median one-third of distal margin (Fig. 185). *Coloration.* Black, except light brown to ferruginous on antennal flagellum, tegula, trochanter (sometimes black), femur, and tarsi; yellow as follows: outer surface of mandible, apical third of labrum (usually reduced), clypeus, except distal margin, inferior paraocular area, anterior surface of scape (usually reduced), medially interrupted band on vertex, pronotal lobe, anterior half of tegula, anterolateral and lateral margins of scutum with continuous broad band (usually interrupted), axilla, distal margin of scutellum (sometimes medially narrowed or broken), ventral surfaces of coxae (often reduced or absent), inferior margins of femora (usually also on superior margins, distally), outer surfaces of tibiae and basitarsi, terga with complete bands (sometimes medially interrupted on T1, medially and laterally distinctly notched on anterior margin on remaining terga), and sides of S2–S4. Wings hyaline; veins and stigma dark brown. *Pubescence.* Whitish. Outer surfaces of fore and middle basitarsi densely covered by tomentum (integument not visible among hairs). *Sculpturing.* Propodeal triangle dull or weakly shiny, finely lineolate. T1–T5 with weakly elevated discal areas, dull or weakly shiny, finely imbricate, punctures fine, sparse (2–3× PW); depressed marginal zones with fine punctures, as on disc, slightly denser (1–2× PW), nearly impunctate on T5; distal margins dull or weakly shiny, broad, about half width of depressed marginal zone, little differentiated from it, broadest on T5.

*Male.* Body length 8.5–10.8 mm; forewing length 5.8–7.5 mm. *Structure.* F1 1.5× longer than broad, shorter (~0.7×) than combined lengths of F2 and F3. T6 with lateral spine gently curved to nearly straight, about as long as median spine of T7; lateral lobe of T7 apically rounded, about as broad as distance between inner margin and median spine (Fig. 260); S4 without apical brush, at most with few stout pale hairs, distal margin straight; S6, in ventral view, with basal margin gently convex, laterally with small, laterally directed acute spine, ventrally directed in profile, distal margin truncate, not projecting into lobe (Fig. 386); S7 hemisternite somewhat apically truncate (Fig. 463); S8 with distal margin slightly projected on median half of distal margin (Fig. 540). Genitalia: gonostylus slender, 4.3× longer than broad, nearly parallel-sided in profile, apex slightly curved,



pointed; volsella large, about two-thirds of gonostylar length, digitiform, basally swollen on dorsal margin; penis valve broad, slightly shorter than gonostylus, dorsoapical patch of hairs reduced or absent, medial projection large, distinct. *Coloration*. As in female, except: maculations on vertex, tegula, scutum, and scutellum sometimes reduced or absent; terga with bands more deeply notched medially and laterally (sometimes each with four spots); T7 entirely yellow, or with medially interrupted band. *Pubescence*. Longer, denser than in female, especially on face. *Sculpturing*. Terga with integument shinier than in female.

*Distribution*. USA: southern California, southern Arizona, southern New Mexico, western Texas, southern Nevada, south-western Utah. Adjacent MEXICO: Baja California, Sonora, Durango (from –20 to 1500 m a.s.l.). Restricted to the Mojave, Sonoran, Chihuahuan, and Baja California desert ecoregions (Fig. 581).

*Phenology*: Late February–October; most records (5%) from April through first half of June.

*Floral records*: ASTERACEAE: *Baileya multiradiata*, *Baileya multiradiata* var. *pleniradiata*; *Bebbia juncea*; *Helianthus petiolaris* var. *canescens*; *Hymenopappus filifolius*; *Malacothrix* sp.; *Palafoxia arida*, *Palafoxia linearis*; *Pluchea sericea*. BORAGINACEAE: *Cryptantha barbigera*; *Phacelia* sp. EUPHORBIACEAE: *Croton californicus*. FABACEAE: *Acacia greggii*; *Astragalus* sp.; *Marina parryi*; *Melilotus* sp.; *Prosopis juliflora*; *Psoralea scoparius*. KRAMERIACEAE: *Krameria* sp. PLANTAGINACEAE: *Penstemon albomarginatus*. POLEMONIACEAE: *Eriastrum diffusum*. POLYGONACEAE: *Eriogonum inflatum*. TAMARICACEAE: *Tamarix* sp. ZYGOPHYLLACEAE: *Larrea divaricata*, *Larrea tridentata*.

*Biology*: Newberry (1900) observed a single nest of this species in hard sand, and two cuckoo bees entering the nest. According to Hurd & Linsley (1975), this desert species has two flight periods, one in the spring, from April to May, and one in autumn (October).

#### *ANTHIDIUM PENAI* MOURE, 1957

FEMALE, FIGS 108, 186; MALE, FIGS 261, 318, 387, 464, 541

*Anthidium penai* Moure, 1957: 209 (holotype: DZUP; ♀, El Clarillo, Santiago, Chile).

*Diagnosis*: Superficially this species resembles *A. adriani*, *A. rubripes*, and *A. sparsipunctatum*

sp. nov. in the body black, with antenna, tegula, and most segments of legs ferruginous. The female can be easily separated from those species and any other NW *Anthidium* by the T6 gently convex basally, with a lateral spine distinctly long and acute, and distal margin medially produced, with oval emargination (Fig. 186). The male can be easily separated by the following combination of characters: T7 with lateral lobe elongate, apically rounded, and gently bent dorsally (Fig. 261); S4 with apical hair brush on the weakly projected median one-quarter of the distal margin (Fig. 318); and S6 with apicolateral margin thickened, ventrally bent, and distal margin thinner, sinuous (Fig. 387).

*Description: Female*. Body length 13.5 mm; forewing length 8.9 mm. *Structure*. Clypeus weakly convex, projected about 0.4× width of compound eye in profile, distal margin thick, straight or gently wavy, slightly projected sublaterally (Fig. 108); mandible with six or seven teeth; labrum without basal protuberances, preapical projections large, distinctly curved upwards; F1 almost twice as long as broad, slightly shorter (~0.9×) than combined lengths of F2 and F3. Tibial carina absent. T6 gently convex basally, with distinctly long, acute lateral spine, preapical carina absent, distal margin pointed, with broad, deep median emargination (Fig. 186). *Coloration*. Black, except ferruginous on antenna (darker on superior margin of F5–F10), pronotal lobe (sometimes darkened), tegula, most of femora, and remaining segments of legs; cream or yellow as follows: small oval spot laterally on vertex, and T1–T5 with medially interrupted bands, closer on apical terga, laterally usually deeply notched on posterior margin. Wings light orange basally, brownish distally; veins ferruginous basally (including stigma and prestigma), dark brown distally. *Pubescence*. Whitish, except light ferruginous to yellowish hairs on vertex, dorsum of mesosoma, and tarsi; dark-brown to black hairs on depressed marginal zones of T1–T5, and T6 entirely. Fore basitarsus with sparse fringe of long hairs ( $\geq 2\times$  basitarsal width) along posterior margin. Outer surface of hind tibia covered with distinctly shorter, thicker hairs than those on anterior margin; outer surface of hind basitarsus with unmodified hairs. *Sculpturing*. Propodeal triangle dull, lineolate. T1–T5 with weakly elevated discal areas, dull or weakly shiny between sparse punctures ( $2-4\times$  PW); depressed marginal zones with slightly denser punctures than on discs ( $2-3\times$  PW); distal margins narrow ( $3-4\times$  PW), little differentiated from rest of depressed marginal zone, broadest on T1 (about one-third width of depressed marginal zone).

*Male*. Body length 13–14 mm; forewing length 8.9–10 mm. *Structure*. Labrum without preapical

projections; F1 1.8× longer than broad, shorter (0.6×) than combined lengths of F2 and F3; lateral spine of T6 straight, about as long as median spine of T7; lateral lobe of T7 elongate, rounded, gently bent dorsally at apex, narrower than distance between inner margin and median spine (Fig. 261); S4 with apical brush of short, dense black hairs on median one-quarter of gently projected distal margin (Fig. 318); S6, in ventral view, with gently convex basal margin, laterally thickened, ventrally bent, distal margin thinner, sinuous (Fig. 387); S7 hemisternite as in Figure 464; S8 with short, curved, simple apical process, basally about one-third width of distal margin (Fig. 541). Genitalia: gonostylus 3.0× longer than broad, laterally compressed; volsella small, about one-third of gonostylar length, ventrally pointed in profile; penis valve short, slightly more than two-thirds of gonostylar length, apex narrow, pointed, blade-like, curved, dorsoapical patch of hairs absent, medial projection large, distinct. *Coloration*. As in female, except yellow on outer surface of mandible, clypeus, inferior paraocular area, and anterior surface of scape; basitarsi yellowish. *Pubescence*. Head and mesosoma sometimes with entirely whitish hairs.

*Distribution*: CHILE: Coquimbo to Araucania (100–2100 m a.s.l.). Recorded from Chilean matorral and Valdivian temperate forest ecoregions.

*Phenology*: Late September–early January.

#### *ANTHIDIUM PERUVIANUM* SCHROTTKY, 1910

FEMALE, FIGS 11, 109, 187; MALE, FIGS 262, 388, 465, 542

*Anthidium peruvianum* Schrottky, 1910: 270 (lectotype: MZUSP; ♂, Apurimac, Peru); Urban, 2001a: 268 (type designation).

*Diagnosis*: This species is similar to *A. spatulatum* sp. nov. and *A. toro* in the small body size and colour (black except for vertex, with oval spot laterally, and terga with complete or medially interrupted bands), F1 elongate, labrum with strong basal protuberances (Fig. 11), sternal scopa pale, hind tibia without carina, and shape of male T7 (Fig. 262). The female can be easily separated from these and any other species of *Anthidium* by T6 distinctly depressed, nearly concave in profile, with distal margin strongly convex between the lateral and submedian spines (Fig. 187). The male can be distinguished by the S6 with lateral lobe rather long, pointed, and distal margin with midapical emargination about as broad as deep (Fig. 388).

*Description: Female*. Body length 7.7–9.2 mm; forewing length 6.3–6.9 mm. *Structure*. Clypeus prominently convex, projected about 0.4× width of compound eye, distal margin thin, wavy to gently tuberculate (Fig. 109); mandible with five teeth; labrum with strong basal protuberances, visible even when mandibles closed, separated by about 2.0× width of protuberance, preapical projections absent; F1 elongate, about 2.7× longer than broad, about as long as combined lengths of F2 and F3. Tibial carina absent. T6 distinctly depressed, nearly concave in profile, distal margin crenulate, strongly convex between lateral and submedian spines, about 3.0× distance between submedian spines (Fig. 187). *Coloration*. Black, except brownish to light ferruginous on antenna and distitarsi; yellow or cream as follows: distal half of clypeus, except medially, oval to rounded spot laterally on vertex, and terga with complete bands laterally, slightly notched on posterior margin on basal three terga, medially interrupted on remaining segments (T3 sometimes with briefly interrupted band, T6 usually with large submedian spot and small, diffuse, lateral spot). Wings hyaline, slightly brownish; veins and stigma dark brown. *Pubescence*. Whitish, except light ferruginous hairs on inner surfaces of tarsi; brownish hairs on vertex, scutellum (intermingled with whitish hairs), depressed marginal zones of T1–T5, and apex of S6. Fore basitarsus with sparse fringe of long hairs ( $\geq 2\times$  basitarsal width) along posterior margin. *Sculpturing*. Propodeal triangle shiny, finely lineolate, nearly smooth. T1–T5 with weakly elevated discal areas, smooth, shiny between dense punctures (1–3× PW); depressed marginal zones slightly more densely punctate than on discs (1–2× PW); distal margins shiny, about one-quarter width of depressed marginal zone, T6 sparsely punctate, with large impunctate areas.

*Male*. Body length 10.2–10.8 mm; forewing length 7.7–8.0 mm. *Structure*. Labrum with basal protuberances lower than in female, tuberculiform; F1 slightly more than two times longer than broad, slightly shorter (0.9×) than combined lengths of F2 and F3. Lateral spine of T6 gently curved, stouter, longer than median spine of T7; lateral lobe of T7 as broad as distance between inner margin and median spine, narrow, curved apically, outer margin gently convex, inner margin crenulate, basally oblique (Fig. 262); S4 without apical brush, distal margin straight; S6, in ventral view, with strongly convex basal margin, lateral lobe long, pointed, posteroventrally directed, median emargination about as broad as deep on one-seventh width of gently projected distal margin (Fig. 388); S7 hemisternite apically rounded (Fig. 465); S8 with short, curved, simple apical process, basally about one-third width of distal margin (Fig. 542). Genitalia: gonostylus robust, about

3.0× longer than broad; volsella very small, less than one-third of gonostylar length, apically truncate; penis valve slightly shorter than gonostylus, rather narrow, apically pointed (not blade-like), dorsoapical patch of hairs absent, medial projection large, distinct. *Coloration*. As in female, except yellow or cream on outer surface of mandible, clypeus, and inferior paraocular area. *Sculpturing*. Terga slightly shinier, with broader distal margins than in female, about one-third width of depressed marginal zone.

*Distribution*. PERU: Apurimac, Huánuco, Ica, Lima (2400–4000 m a.s.l.). Recorded from the Sechura Desert and Central Andean wet puna ecoregions.

*Phenology*: May–July, November.

*Floral records*: ASTERACEAE: *Grindelia* sp.

#### *ANTHIDIUM PLACITUM* CRESSON, 1879

FEMALE, FIGS 19, 110, 188; MALE, FIGS 263, 319, 389, 466, 543; MAP, FIG. 581

*Anthidium placitum* Cresson, 1879: 206 (holotype: ANSP 2393; ♀, Nevada, USA); Cresson, 1916: 128 (type designation).

*Anthidium bernardinum* Cockerell, 1904c: 74 (holotype: USNM 13666; ♂, Strawberry Valley, California, USA); Schwarz, 1928: 377 (synonymy with *placitum*).

*Anthidium hesperium dentipygum* Swenk, 1914: 19 (holotype: UNSM; ♀, Laramie, Wyoming, USA); Grigarick & Stange, 1968: 31 (synonymy with *placitum*).

*Anthidium permaculatum* Cockerell, 1925a: 349 (holotype: CAS 1732; ♀, Sparta, Baker Co., Oregon, USA); Grigarick & Stange, 1968: 31 (synonymy with *placitum*).

*Anthidium bernardinum* var. *mesaverdense* Schwarz, 1927b: 15 (holotype: AMNH; ♀, Mesa Verde, Colorado, USA); Grigarick & Stange, 1968: 31 (synonymy with *placitum*).

*Anthidium niveumtarsum* Schwarz, 1927b: 18 (holotype: AMNH; ♀, Jackson, Wyoming, USA); Grigarick & Stange, 1968: 31 (synonymy with *placitum*).

*Diagnosis*: The female of this species resembles that of *A. edwardsii* and *A. pallidiclypeum* in the clypeus covered with apically hooked or wavy hairs, and the distal margin with a wide V-shaped emargination (Fig. 110). As in *A. edwardsii*, the clypeus is weakly convex, with acute sublateral teeth on distal margin, but T6 is laterally projected into a blunt tooth or angle (Fig. 188), which is absent in *A. edwardsii* and *A. pallidiclypeum*. In the male, the lateral lobe of T7 is broad, not apically narrowed (Fig. 263), and the

lateral lobe of S6 is small and medially directed in ventral view (Fig. 389). The lateral lobe of T7 is also broad in *A. pallidiclypeum*, but with a different shape (Fig. 256), and narrow and pointed in *A. edwardsii* (Fig. 232); the lateral lobe of S6 is laterally directed in *A. edwardsii* and reduced to nearly absent in *A. pallidiclypeum*.

*Description*: *Female*. Body length 11.5–13.8 mm; forewing length 8.0–10.0 mm. *Structure*. Clypeus weakly convex, nearly flat, projected about 0.2× width of compound eye, distal margin thin, with acute sublateral teeth (Fig. 110); mandible with five teeth; labrum gently elevated basally, preapical projections large, distinctly curved upwards; F1 2.1× longer than broad, shorter (~0.8×) than combined lengths of F2 and F3. Tibial carina absent. T6 gently convex in profile, preapical carina absent, laterally with distinct blunt tooth or angle, depressed apical rim projecting on three-quarters of distal margin (Fig. 188). *Coloration*. Dark brown to black, except: light brown on tarsi; yellow as follows: outer surface of mandible, clypeus, except along midline (sometimes only on distal two-thirds), inferior paraocular area, medially interrupted band on vertex, pronotal lobe, tegula, except on disc, anterolateral and lateral margins of scutum with continuous broad band (sometimes interrupted), axilla, distal margin of scutellum, except medially, apices of coxae and trochanters (often reduced or absent), inferior margins of femora distally (usually also on superior margins), outer surface of tibiae (sometimes also on hind basitarsus), and terga usually with complete bands laterally notched on anterior margin (sometimes medially interrupted, often broken into four spots on T1). Wings hyaline, slightly brownish; veins and stigma dark brown. *Pubescence*. Whitish, except yellowish on vertex, scutum, axilla, scutellum, and inner surfaces of tarsi. Clypeus covered with simple, apically hooked or wavy hairs. Outer surfaces of fore and middle basitarsi densely covered by tomentum (integument not visible among hairs). *Sculpturing*. Propodeal triangle dull or weakly shiny, finely lineolate. T1–T5 with weakly elevated discal areas, especially on basal two terga, shiny, weakly lineolate to smooth between punctures (1–2× PW); depressed marginal zones uniformly punctate, punctures nearly contiguous, coarser than on discs; distal margins shiny, narrow (2–3× PW), thick, weakly doubly carinate.

*Male*. Body length 10.0–14.6 mm; forewing length 7.2–9.4 mm. *Structure*. F1 1.7× longer than broad, shorter (~0.7×) than combined lengths of F2 and F3. T6 with lateral spine gently curved to nearly straight, about as long as median spine of T7; lateral lobe of T7 broadly rounded, almost twice as broad as distance between inner margin and median spine (Fig. 263);



S4 with apical brush of reddish hairs on median one-fifth of distal margin (Fig. 319); S6, in ventral view, with basal margin gently convex, laterally with medially directed lobe, median lobe subtriangular, about twice as broad as long, apically notched (Fig. 389); S7 hemisternite with truncate distal margin (Fig. 466); S8 with long, narrow, bifid apical process, heron or egret's head shape in profile, with curved lobes in posterior view (Fig. 543). Genitalia: gonostylus robust, 2.7× longer than broad, apically pointed in ventral view; volsella small, about one-third of gonostylar length, triangular in ventral view, subrectangular in profile; penis valve about half of gonostylar length, apically broad, flattened, dorsoapical patch of hair present, medial projection small. *Coloration*. As in female, except yellow on clypeus, basitarsi, and T7 with two spots (sometimes absent); maculations on vertex and scutum usually reduced. *Sculpturing*. Terga shinier than in female.

*Distribution*: USA: from California, Oregon, and southern Washington to western South Dakota, Colorado, and Arizona. Adjacent MEXICO: mountains of northern Baja California (0–3200 m a.s.l.). Well represented in shrub steppe (40% of records), Colorado Plateau shrublands (30%), California chaparral and woodlands (17%), and forest (11%) ecosystems (Fig. 581).

*Phenology*: April–September; one record for 16 October. Records from last half of June through September account for 97% of records.

*Floral records*: ASTERACEAE: *Carthamus* sp.; *Chrysopsis villosa*; *Chrysanthamnus viscidiflorus*; *Cirsium calcareum*, *Cirsium neomexicanum*, *Cirsium vulgare*; *Encelia farinosa*; *Erigeron divergens*; *Gutierrezia californica*; *Helianthus annuus*, *Helianthus petiolaris*; *Heterotheca villosa*; *Hymenoxys cooperi*; *Solidago confinis*; *Tetradymia canescens*; *Yermo xanthocephalus*. BORAGINACEAE: *Cryptantha intermedia*; *Eriodictyon trichocalyx*; *Phacelia heterophylla*. CHENOPODIACEAE: *Salsola tragus*. CLEOMACEAE: *Cleome serrulata*. FABACEAE: *Lotus nevadensis* var. *nevadensis*, *Lotus oblongifolius*, *Lotus scoparius*; *Medicago sativa*; *Melilotus alba*. GROSSULARIACEAE: *Ribes* sp. LAMIACEAE: *Monardella* sp. OROBANCHACEAE: *Castilleja* sp.; *Cordylanthus filifolius*, *Cordylanthus nevini*, *Cordylanthus parviflorus*, *Cordylanthus rigidus* spp. *brevibracteatus*, *Cordylanthus wrightii*. PLANTAGINACEAE: *Penstemon personatus*. POLEMONIACEAE: *Gilia leptalea* spp. *bicolor*. POLYGONACEAE: *Eriogonum nudum*, *Eriogonum wrightii* var. *subscaposum*.

*Comments*: Specimens from California have the propodeum dull, T1–T5 with depressed marginal zones with punctures more densely packed, and male T7 with lateral lobe nearly straight on its outer margin, and angulate on inner margin.

#### ANTHIDIUM PLATYFRONS SP. NOV.

FEMALE, FIGS 111, 189; MALE, FIGS 36, 320, 390, 467, 544, 573

*Diagnosis*: Both sexes of this species are most similar to *A. tenuiflorae* in the absence of the tibial carina, the sternal scopa white, and the female T6 convex, with depressed apical rim projecting on almost the entire distal margin (Fig. 189). The male resembles that species in the T7 with lateral lobe rounded (Fig. 36), S4 with apical brush of dense, long hairs (Fig. 320), and S6 with distinct lateral and median lobes (Fig. 390). The female can be easily separated from *A. tenuiflorae* and any other NW *Anthidium* by the small body size and the face distinctly flat, with unmodified integument, and covered with apically hooked or wavy hairs (Fig. 111). The male is easily separated from *A. tenuiflorae* by the S6 with the outer margin of the lateral lobe straight and S8 with apical process shorter and broader (Fig. 544).

*Description*: *Female*. Body length 6.3 mm; forewing length 4.9 mm. *Structure*. Clypeus prominently flat, distal margin thin, straight between sublateral tubercles (Fig. 111); mandible with five teeth; labrum without basal protuberances, preapical projections large, distinctly curved upwards; F1 1.3× longer than broad, shorter (~0.7×) than combined lengths of F2 and F3. Tibial carina absent. T6 gently convex, without distinct lateral angle, preapical carina absent, depressed apical rim projecting on 0.8× distal margin (Fig. 189). *Coloration*. Dark brown to black, except ferruginous on inner surfaces of fore and middle femora and tarsi; yellow as follows: outer surface of mandible, distal half of clypeus with two large spots nearly touching medially, inferior paraocular area, medially interrupted band on vertex, anterolateral and lateral margins of scutum (not forming continuous band), tegula, except on disc, pronotal lobe, axilla, distal margin of scutellum, except medially, inferior and superior surfaces of femora distally, outer surfaces of fore and middle tibiae, posterior margin of hind tibia, basitarsi, and terga, with medially interrupted bands, closer on apical terga, deeply notched laterally on anterior margin (T1 notched on posterior margin). Wings hyaline, slightly brownish; veins and stigma dark brown. *Pubescence*. Whitish, except yellowish hairs on vertex, scutum, axilla, scutellum, inner surfaces of tarsi, and metasoma. Clypeus, supraclypeus, and frons covered with

apically curved or wavy hairs. Outer surfaces of fore and middle basitarsi sparsely covered by tomentum (integument barely visible among hairs). *Sculpturing*. Propodeal triangle smooth and shiny. T1–T5 with weakly elevated discal areas, smooth, shiny between punctures (1–2× PW); depressed marginal zones densely punctate ( $\leq 1.0 \times$  PW), punctures as large as those on discs; distal margins narrow (1–2× PW).

*Male*. Body length 8.8 mm; forewing length 6.2 mm. *Structure*. F1 1.2× longer than broad, shorter (0.6×) than combined lengths of F2 and F3; labrum with preapical projections larger than in female. Lateral spine of T6 straight, about as long as median spine of T7; lateral lobe of T7 apically rounded, 1.5× broader than distance between inner margin and median spine (Fig. 36); S4 with apical brush of long, black hairs on weakly concave median one-third of distal margin (Fig. 320); S6, in ventral view, with gently convex basal margin, lateral lobe acute, posteriorly directed, median lobe about as long as broad, apically notched (Fig. 390); S7 hemisternite apically pointed (Fig. 467); S8 with broad, bifid apical process, 0.4× width of distal margin, with pointed lobes ventrally bent in nearly right angle (Fig. 544). Genitalia: gonostylus 3.0× longer than broad; volsella small, about one-third of gonostylar length, subrectangular in profile, triangular in ventral view; penis valve about half of gonostylar length, broad, apically with small, ventrally curved projection, dorsoapical patch of hairs present, medial projection small (Fig. 573). *Coloration*. As in female, except yellow on clypeus, anterior surface of scape, ventral surfaces of fore and hind coxae, outer surfaces of fore and middle tibiae, T1 and T2 each with four spots, and T6 with broad submedian spot, medially notched on anterior margin; maculations on vertex, scutum, axilla, and scutellum reduced.

*Holotype*: ♀, USA: Arizona, Maricopa Co. Rainbow Valley, J. Gillespie // G. Butler crop, flight trap, V-2–1980 (BBSL).

*Paratypes*: 2 males. USA: Arizona, Maricopa Co., 1♂, same data as the holotype; 1♂, Arlington, 10 mi S, Gila River, 200 m a.s.l., 3–7 Jun 2010, M.E. Irwin, F.D. Parker (BBSL, UAIC).

*Distribution*: USA: Arizona (200–300 m a.s.l.). Rare, apparent endemic of the Sonoran Desert. Known from only two localities south-west of Phoenix, in areas currently largely under agricultural cultivation.

*Phenology*: May–early June.

*Etymology*: The specific epithet refers to the flat face in the female of this species.

*Comments*: The middle tibia and remainder of the left leg is missing in the holotype. The outer surfaces of the fore and middle basitarsi of the female seem to be sparsely covered with tomentum, but we cannot tell with certainty because the specimen is old and the hairs are plastered against the integument.

#### *ANTHIDIUM PORTERAE* COCKERELL, 1900

FEMALE, FIGS 18, 112, 190; MALE, FIGS 264, 321, 391, 468, 545; MAP, FIG. 581

*Anthidium porterae* Cockerell, 1900: 411 (lectotype: AMNH; ♂, Las Vegas, New Mexico, USA) (**new lectotype designation**).

*Anthidium porterae* var. *amabile* Cockerell, 1904d: 7 (holotype: USNM 9655; ♂, Pecos, New Mexico, USA); Michener 1951: 1141 (synonymy with *porterae*).

*Anthidium porterae personulatum* Cockerell, 1907a: 135 (lectotype: AMNH; ♂, Boulder, Colorado, USA) (**new lectotype designation**); Michener 1951: 1141 (synonymy with *porterae*).

*Diagnosis*: This species is easily separated from all other NW *Anthidium* by the female T6 with depressed apical rim laterally projecting into a distinct ventral lobe (Fig. 190), and male S6 with median discal carina distinctly projecting as a long spine (Fig. 391). The female of *A. porterae* is similar to *A. cochimi* in the clypeus weakly convex with apically hooked or wavy hairs, hind basitarsus with tomentum on the outer surface, and T6 with depressed apical rim slightly projected laterally into a small ventral lobe; however, in *A. porterae* the preapical labral projections are large and distinct (as in Figs 12, 13), and T6 is distinctly elevated along the midline, with the ventral lobe more strongly projecting. In *A. cochimi* the preapical labral projections are nearly absent, barely indicated as an elevated ridge near to the apex of the median furrow, and T6 is not elevated along the midline.

*Description: Female*. Body length 9.2–12.3 mm; forewing length 7.2–8.8 mm. *Structure*. Clypeus weakly convex, projected about 0.3× width of compound eye in profile, distal margin straight between sublateral tubercles (Fig. 112); mandible with six or seven teeth; labrum with distinct basal protuberances, separated by about width of protuberance, preapical projections large, distinctly curved upwards; F1 1.8× longer than broad, shorter (0.7×) than combined lengths of F2 and F3. Tibial carina present (Fig. 18). T6 convex in profile, distinctly elevated along midline, lateral angle small but distinct, preapical carina minutely crenulate, depressed apical rim visible on median one-sixth of distal margin, laterally projecting into distinct ventral lobe (Fig. 190). *Coloration*. Dark brown to black, except ferruginous on legs and metasoma;

yellow as follows: outer surface of mandible, apical third of clypeus (usually broadly interrupted medially), inferior paraocular area, broad oval or rounded spot laterally on vertex, pronotal lobe, tegula, except on disc (sometimes only on anterior half), anterolateral and lateral margins of scutum (usually reduced), axilla, distal half of scutellum, except medially, outer surfaces of tibiae basally (extending almost to apex on fore tibia), T1 and T2 each usually with four spots, T3–T5 with medially interrupted bands, deeply notched laterally on anterior margin, and T6 with two large submedian spots. Wings hyaline, slightly brownish; veins and stigma dark brown. *Pubescence*. Whitish, usually yellowish on vertex, scutum, axilla, scutellum, inner surfaces of tarsi, and sometimes S6. Clypeus and distal half of supraclypeal area sparsely covered with apically hooked or wavy hairs. Outer surfaces of basitarsi densely covered by tomentum (integument not visible among hairs). *Sculpturing*. Propodeal triangle dull, finely imbricate to lineolate. T1–T5 with strongly elevated discal areas, dull or weakly shiny, weakly imbricate between punctures (1–2× PW); depressed marginal zones with coarse punctures as on discs, denser ( $\leq 1.0\times$  PW); distal margins thick, doubly carinate, narrow (2–3× PW).

*Male*. Body length 11.5–13.1 mm; forewing length 7.7–9.5 mm. *Structure*. Labrum with basal protuberances slightly closer than in female, separated by less than width of protuberance; F1 1.5× longer than broad, shorter (0.7×) than combined lengths of F2 and F3. Lateral spine of T6 gently curved, about as long as median spine of T7; lateral lobe of T7 subquadrate, 1.5× broader than distance between inner margin and median spine (Fig. 264); S4 with broad, dense, apical brush of reddish brown hairs on median one-third of weakly concave distal margin (Fig. 321); S6, in ventral view, with gently convex basal margin, without lateral lobe, distal margin projecting into distinct median lobe, lateral discal carina low, median discal carina distinctly projected as long spine (Fig. 391); S7 hemisternite apically pointed (Fig. 468); S8 with long, broad, weakly bifid apical process, basally about one-third width of distal margin (Fig. 545). Genitalia: gonostylus slender, 4.3× longer than broad, parallel-sided in profile; volsella large, about two-thirds of gonostylar length, broader than gonostylus in profile, basally swollen, curved on dorsal margin; penis valve about as long as gonostylus, apically flat, pointed, dorsoapical patch of hairs present, medial projection large, distinct. *Coloration*. As in female, except yellow on clypeus, basitarsi, and T7 laterally (usually absent). *Sculpturing*. Terga slightly shinier than in female.

*Distribution*: USA: from Arizona, Utah to Wyoming, South Dakota, Nebraska, Oklahoma, Texas. MEXICO:

from Baja California Sur, Chihuahua to Aguascalientes, San Luis Potosí (400–2800 m a.s.l.). Occurs in the Northern and Western short grasslands, Central and Southern mixed grasslands, Edwards Plateau savanna, Colorado Rockies, and Arizona Mountain forests, Colorado Plateau shrublands, Chihuahuan Desert, Sierra Madre Occidental pine–oak forests, and Meseta Central matorral ecoregions. Appears most abundant in the Chihuahuan Desert (33% of records) and the Western short grasslands (34%), where it is the dominant *Anthidium* (Fig. 581).

*Phenology*: April–early November; latter half of June through first half of September accounts for 90% or records.

*Floral records*: APOCYNACEAE: *Asclepias* sp. ASTERACEAE: *Cirsium* sp.; *Erigeron compositus*; *Liatris* sp.; *Psilostrophe* sp. BORAGINACEAE: *Phacelia distans*, *Phacelia robusta*. FABACEAE: *Dalea candida* var. *oligophylla*; *Hoffmannseggia* sp.; *Lotus* sp.; *Medicago sativa*; *Melilotus officinalis*; *Petalostemon* sp.; *Psoralea tenuiflora*; *Psoralea thamnus* sp. LOASACEAE: *Mentzelia multiflora*. PLANTAGINACEAE: *Penstemon* sp.

*Biology*: This species presumably uses only pebbles in the nest plug. Hicks (1926) described the pebble-gathering behaviour and the architecture of one nest built inside an unoccupied hole in the ground. The nest consisted of a single cell at the bottom of a short burrow (~7.6 cm deep and ~2.5 cm wide). Custer & Hicks (1927) observed other aspects of the nesting habits, including the trichome-collecting behaviour on *Artemisia campestris* (Asteraceae) and *Cryptantha* sp. (Boraginaceae). Custer & Hicks (1927: 258) also indicated that the species studied by Hungerford & Williams (1912) in Kansas was *A. porterae*, not *A. maculifrons*. Both species have been recorded from Kansas, and we have not seen the specimens of Hungerford & Williams (1912) to confirm their identity. Males are territorial at host plants preferred by females (Villalobos & Shelly, 1991).

*Comments*: Cockerell described *A. porterae* in 1900 and *A. porterae personulatum* in 1907, from both sexes, and from the same locality, and did not designate a holotype in the original publication. Each male and female specimen of *A. porterae personulatum* in the AMNH has a ‘type’ label, and thus, a lectotype designation is appropriate to stabilize the name. Given that Cockerell described *A. porterae* seven years earlier, it is likely that he also used a ‘type’ label for all specimens; however, we have seen only a male with a ‘type’ label at the AMNH; the female is apparently missing (J. Ascher, pers. comm. 2009). As first reviewers, we are designating the male specimen as



the lectotype of *A. porterae personulatum* and the available male as the lectotype of *A. porterae*. The complete label data for the lectotype of *A. porterae* are as follows: 'Las Vegas, N.M. Aug. 11. (W. Porter) // (illegible) of *Petalostemon candidus* // *Anthidium maculifrons* Smith. ♂ // ac. 34242/ *A. porterae* Ckll. TYPE // (red label) ♂ Lectotype *Anthidium porterae* Cockerell Des. V.H. Gonzalez & T. Griswold 2009'. The label data for the lectotype of *A. porterae personulatum* are as follows: 'Boulder, Colo. W. P. Cockerell, Aug. 8-06 *Psoralea* // *A. porterae* var. // *Anthidium porterae personulatum* Ckll. TYPE ♂ // (red label) ♂ Lectotype *Anthidium porterae personulatum* Cockerell Des. V.H. Gonzalez & T. Griswold 2009'.

#### *ANTHIDIUM PSORALEAE* ROBERTSON, 1902

FEMALE, FIGS 14, 113, 191; MALE, FIGS 265, 322, 392, 469, 546; MAP, FIG. 580

*Anthidium psoraleae* Robertson, 1902: 322 (lectotype: INHS 8982; ♀, Carlinville, Illinois, USA); Mitchell 1962: 11–13 (redescription); Webb 1980: 117 (lectotype designation by W.E. LaBerge).

**Diagnosis:** Both sexes of this species are similar to those of *A. clypeodentatum* (see above). The female can be separated from *A. clypeodentatum* by the clypeus weakly convex, with distal margin non-tuberculate (Fig. 113), and T6 with lateral spine small, but distinct on the preapical carina (Fig. 191). The male can be easily recognized by the S6 with median lobe distinctively subrectangular (Fig. 392).

**Description: Female.** Body length 11.5 mm; forewing length 8.0 mm. **Structure.** Clypeus weakly convex, projected about 0.5× width of compound eye in profile, distal margin straight or nearly straight between low sublateral tubercles (Fig. 113); mandible with seven or eight teeth of similar sizes; labrum without basal protuberances, preapical projections large, distinctly curved upwards; F1 1.8× longer than broad, shorter (0.7×) than combined lengths of F2 and F3. Tibial carina absent. T6 distinctly elevated along midline, preapical carina minutely crenulate, lateral margin gently convex, with small but distinct lateral spine or projection, distal margin narrowly projected medially (Fig. 191). **Coloration.** Dark brown to black, except yellow or cream as follows: outer surface of mandible (usually absent), broad longitudinal band laterally on vertex, pronotal lobe (sometimes reduced or absent), anterior margin of tegula, lateral margin of scutum (usually reduced), axilla (sometimes reduced), distal half of scutellum, except medially (sometimes reduced), outer surface of hind basitarsus (usually absent), T1 with four spots (submedian spots sometimes reduced), and T2–T5 with

medially interrupted bands, closer on apical terga, laterally deeply notched on anterior margin. Wings hyaline, slightly brownish; veins and stigma dark brown. **Pubescence.** Whitish, except yellowish to brownish hairs on inner surfaces of tarsi. Clypeus with simple, apically curved hairs. Scape with posterior surface densely covered by tomentum (Fig. 14). Outer surfaces of fore and middle basitarsi sparsely covered by tomentum (integument barely visible among hairs). **Sculpturing.** Propodeal triangle shiny, weakly lineolate to imbricate. T1–T5 with strongly elevated discal areas, weakly shiny, weakly imbricate, nearly smooth between dense, coarse punctures (1–2× PW); depressed marginal zone punctures slightly smaller, closer than on discs; distal margins thick, doubly carinate, broadest on T1 (3–4× PW), progressively decreasing in width towards apical terga, narrowest on T5 ( $\leq 1.0\times$  PW).

**Male.** Body length 12.0–13.8 mm; forewing length 8.6–8.8 mm. **Structure.** Labrum without distinct basal protuberances; F1 1.7× longer than broad, shorter (0.6×) than combined lengths of F2 and F3. Lateral spine of T6 gently curved, about as long as median spine of T7; lateral lobe of T7 broad, about 1.5× broader than distance between inner margin and median spine, with acute inner angle (Fig. 265); S4 without distinct apical brush, with some thick, reddish brown hairs on narrowly concave median one-third of distal margin (Fig. 322); S6, in ventral view, with basal margin medially projected, with short, low, sublateral carina on disc, lateral lobe absent, median lobe large, subrectangular, broader at apex, apically notched (Fig. 392); S7 hemisternite somewhat rounded (Fig. 469), with strong apodeme, as seen in profile; S8 with sinuous distal margin, weakly sclerotized along midline distally (Fig. 546). **Genitalia:** gonostylus robust, 3.3× longer than broad; volsella small, about one-third of gonostylar length, ventrally narrow, pointed, dorsally broadly rounded, medially directed; penis valve about half of gonostylar length, broad, apex with small lateral and medial projections, dorsoapical patch of hairs present, medial projection small. **Coloration.** As in female, except yellow maculations as follows: outer surface of mandible, clypeus, inferior paraocular area, outer surfaces of tibiae distally, basitarsi, and small submedian spot on T6; maculations on vertex and dorsum of mesosoma usually reduced or absent. **Pubescence.** Posterior surface of scape not covered by dense tomentum, as in female.

**Distribution:** Central USA: from the Great Plains (Oklahoma, Kansas, Nebraska) to Arkansas, Minnesota, Michigan (200–700 m a.s.l.). Occurs in grassland and forest ecoregions (Fig. 580).

*Phenology:* June–July.

*Floral records:* CAMPANULACEAE: *Lobelia* sp. FABACEAE: *Astragalus* sp.; *Psoralea cuspidata*, *Psoralea tenuiflora*; *Tephrosia* sp.; *Trifolium* sp. VERBENACEAE: *Verbena* sp.

*ANTHIDIUM QUETZALCOATLI* SCHWARZ, 1933

FEMALE, FIGS 114, 192; MALE, FIGS 266, 393, 470, 547; MAP: 581

*Anthidium quetzalcoatl* Schwarz, 1933: 2 (holotype: BMNH 17A.1917; ♀, R. Papagaio, Guerrero, Mexico).

*Diagnosis:* This is the only North American species with a sharp, nearly carinate preoccipital border in both sexes. Furthermore, the shape of T6 of the female (Fig. 192), and T7 (Fig. 266), S6 (Fig. 393), and S8 (Fig. 547) of the male, are distinctive.

*Description: Female.* Body length 10.0–12.3 mm; forewing length 7.4–8.5 mm. *Structure.* Clypeus weakly convex, projected about 0.3× width of compound eye in profile, distal margin thin, non-tuberculate, gently concave medially (Fig. 114); mandible with six teeth; labrum gently elevated basally, without tubercles, preapical projections absent; F1 1.8× longer than broad, shorter (0.8×) than combined lengths of F2 and F3. Preoccipital border sharp, nearly carinate. Tibial carina present. T6 straight in profile, with small but distinct lateral spine, preapical carina minutely crenulate, depressed marginal rim projecting on entire convex distal margin (Fig. 192). *Coloration.* Black, except: dark brown on antenna and legs, excluding tibiae and basitarsi; yellow as follows: outer surface of mandible, apicolateral areas of clypeus, inferior paraocular area, medially interrupted broad band on vertex, pronotal lobe (usually reduced), anterior half of tegula (usually reduced), anterolateral and lateral margins of scutum with continuous broad band, axilla, distal half of scutellum, outer surfaces of fore and middle tibiae with broad band, except distally, outer surface of hind tibia basally, T1 and T2 usually with four spots (T2 sometimes with medially interrupted band), T3–T5 with complete band (sometimes medially narrowed or interrupted), laterally weakly notched on anterior margin, and T6 with large median spot. Wings hyaline, slightly brownish; veins and stigma dark brown. *Pubescence.* Whitish, except yellowish to brownish hairs on vertex, scutum, axilla, scutellum, and inner surfaces of tarsi. Outer surfaces of basitarsi densely covered by tomentum (integument not visible among hairs). *Sculpturing.* Propodeal triangle dull, finely imbricate to lineolate. T1–T5 with strongly elevated discal areas, dull or weakly shiny, weakly

imbricate between punctures (2–3× PW); depressed marginal zones with coarse punctures as on discs, slightly denser (2–3× PW); distal margins thick, doubly carinate, broadest on T1 (2–3× PW), decreasing in width towards apical terga (1.0× PW on T5).

*Male.* Body length 13.1–14.6 mm; forewing length 8.8–10.3 mm. *Structure.* F1 1.7× longer than broad, shorter (0.7×) than combined lengths of F2 and F3. Lateral spine of T6 straight, about as long as median spine of T7; lateral lobe of T7 broad, about 2.0× distance between inner margin and median spine, subrectangular, with sinuous distal margin (Fig. 266); S4 without apical brush of hairs, distal margin straight; S6, in ventral view, with gently convex basal margin, lateral spine small, acute, laterally directed, distal margin medially projecting into short, anteriorly curved spine, not as pointed as in *A. cochimi* (Fig. 393); S7 hemisternite as in Figure 470; S8 with short, weakly bifid apical process, about one-third width of distal margin basally (Fig. 547). *Genitalia:* gonostylus robust, 3.0× longer than broad, broader at apex; volsella long, about half of gonostylar length, somewhat triangular, dorsally protuberant at base; penis valve about half of gonostylar length, apically broad, flat, dorsoapical patch of hairs absent, medial projection large, distinct. *Coloration.* As in female, except yellow on clypeus, anterior surface of scape, outer surfaces of basitarsi (sometimes absent), and T7 with small lateral spot (usually reduced or absent). *Sculpturing.* Terga slightly more densely punctate than in female, distal margins about same width.

*Distribution:* MEXICO: Pacific slope from Oaxaca to Sonora. USA: southern Arizona, a single record from Kitt Peak, Pima County (200–1400 m a.s.l.). Recorded from dry forest and, rarely, pine–oak forest ecosystems (Fig. 581).

*Phenology:* June–September.

*Floral records:* FABACEAE: *Indigofera palmeri*.

*ANTHIDIUM RAFAELI* URBAN, 2001

FEMALE, FIGS 115, 193; MALE, FIGS 267, 394, 471, 548

*Anthidium rafaelli* Urban, 2001b: 546 (holotype: DZUP; ♂, Canta, Lima, Peru).

*Diagnosis:* Superficially, this species resembles *A. adriani*, *A. rubripes*, and *A. sparsipunctatum* sp. nov. in the body black, with legs mostly ferruginous, and terga with medially interrupted bands. The female can be easily recognized by the following combination of characters: F1 elongate (2.5× longer than broad, slightly longer than combined lengths of F2

and F3); terga dull or weakly shiny between dense (1–2× PW), uniform punctures; and T6 with lateral spine small, but distinct, and distal margin gently projected medially, with median emargination broad and shallow (Fig. 193). The male can be easily recognized by T7 with lateral lobe distinctly long, parallel-sided, and apically rounded (Fig. 267), and S6 with lateral lobe long, pointed, and distal margin medially projecting, somewhat concave apically (Fig. 394). The sternal scopa paler, antenna and tegula black, and wings slightly brownish, with dark-brown veins and stigma in both sexes also distinguishing this species from *A. rubripes* and related species.

*Description: Female.* Body length 13.8 mm; forewing length 10.5 mm. *Structure.* Clypeus weakly convex, projected about 0.4× width of compound eye in profile, distal margin thin, gently concave, sublaterally projected (Fig. 115); mandible with six or seven teeth; labrum without basal protuberances, preapical projections large, distinctly curved upwards; F1 2.5× longer than broad, slightly longer than combined lengths of F2 and F3. Tibial carina absent. T6 gently convex basally, with small but distinct lateral spine, preapical carina absent, distal margin gently projected medially, with broad, shallow median emargination, without distinct, depressed, translucent brownish apical rim (Fig. 193). *Coloration.* Black, except: ferruginous on legs, excluding coxae, trochanters, and bases of femora; cream or yellow as follows: short band laterally on vertex, T1–T5 with bands deeply notched laterally on posterior margin, medially interrupted on basal three terga, deeply notched on anterior margin of T4 and T5, and T6 with two large spots. Wings hyaline, slightly brownish; veins and stigma dark brown. *Pubescence.* Whitish, except ferruginous hairs on legs, excluding coxae, trochanters, and bases of femora; dark-brown hairs on clypeus, supraclypeus, vertex, dorsum of mesosoma (intermingled with whitish hairs), depressed marginal zones of T1 and T2, entire surfaces of remaining terga, sides of S2–S4, and S5 and S6 entirely. *Sculpturing.* Propodeal triangle dull, lineolate. T1–T5 with weakly elevated discal areas, dull or weakly shiny between dense, uniform punctures (1–2× PW); depressed marginal zones about as densely punctate as on discs; distal margins narrow (2–3× PW), little differentiated from rest of depressed marginal zone.

*Male.* Body length 18.5 mm; forewing length 12 mm. *Structure.* Labrum without preapical projections, barely indicated by elevated border on lateral margin of furrow; F1 2.4× longer than broad, about as long as combined lengths of F2 and F3. Lateral spine of T6 straight, slightly longer than median spine of T7; lateral lobe of T7 distinctly elongate, 0.7× longer than broad of tergum, parallel-sided, apically

rounded, about 1.5–1.7× wider than distance between inner margin and median spine (Fig. 267); S4 without apical brush, distal margin straight; S6, in ventral view, with basal margin gently convex, lateral lobe long, pointed, laterally directed, distal margin medially projected, apically concave (Fig. 394); S7 hemisternite as in Figure 471; S8 with short, broad, distally notched apical process, basally about one-half width of distal margin (Fig. 548). Genitalia: gonostylus robust, 2.3× longer than broad, dorsoapically pointed; volsella small, about one-third of gonostylar length, somewhat triangular; penis valve about as long as gonostylus, narrow, apically pointed, blade-like, curved, dorsally projecting into a distinct lobe, dorsoapical patch of hairs absent, medial projection large, distinct. *Coloration.* As in female, except yellow on clypeus and inferior paraocular area; yellowish on basitarsi. *Pubescence.* Whitish hairs on clypeus and tarsi; dark brown to black hairs on black areas of legs and sterna.

*Distribution:* PERU: Ancash, Lima (2800–3400 m a.s.l.). Found in the Sechura Desert ecoregion.

*Phenology:* May.

#### *ANTHIDIUM RODECKI* SCHWARZ, 1934

FEMALE, FIGS 116, 194; MALE, FIGS 268, 323, 395, 472, 549; MAP, FIG. 582

*Anthidium rodecki* Schwarz, 1934: 1 (lectotype: UCM; ♂, Roggen, Colorado, USA) (**new lectotype designation**).

*Diagnosis:* The general appearance of this species is similar to that of *A. paroselae* and *A. sonorensis* in the following combination of characters: pubescence white; clypeus weakly convex, with distal margin straight (Fig. 116); legs mostly yellow; and the terga dull or weakly shiny, with complete, light integumental bands, discs finely and sparsely punctate, and distal margins broad. The female can be easily separated from those species by the fore basitarsus with a sparse fringe of long hairs (about as long as width of basitarsus), the absence of a tibial carina, and T6 with a broad, distinctly depressed apical rim, protruding on nearly the entire distal margin (Fig. 194). The male can be recognized by the T7 with lateral lobe broad (Fig. 268), S4 with apical hair brush reddish brown, broad and dense (Fig. 323), and the shape of S6 (Fig. 395) and S8 (Fig. 549).

*Description: Female.* Body length 7.4–10.8 mm; forewing length 5.8–6.7 mm. *Structure.* Clypeus gently convex, projected about 0.4× width of compound eye in profile, distal margin thin, straight, sublateral tuber-



cles not strongly projected (Fig. 116); mandible with six or seven teeth; labrum without basal protuberances, preapical projections small but distinct; F1.7× longer than broad, shorter (~0.8×) than combined lengths of F2 and F3. Tibial carina absent. T6 straight or nearly straight in profile, gently swollen preapically, depressed apical rim broad, distinct, protruding on nearly entire distal margin, median emargination small or absent (Fig. 194). *Coloration*. Black, except: light brownish to ferruginous on tarsi, sterna, and distal margins of terminal terga; yellow as follows: outer surface of mandible (usually absent), apical third of labrum (usually reduced), distal half of clypeus (usually except medially, sometimes reduced or absent), medially interrupted band on vertex (sometimes reduced to small spot behind compound eye), pronotal lobe, tegula except on disc, anterolateral and lateral margins of scutum (usually reduced or absent), axilla, distal margin of scutellum, except medially, ventral surfaces of coxae (often reduced or absent), inferior margins of femora distally (usually also on superior margins distally), outer surfaces of tibia and hind basitarsus, T1–T5 with entire bands, medially notched on anterior margin (sometimes nearly interrupted on T1), and T6, except depressed apical rim and small, oval sublateral spot. Wings hyaline; veins and stigma dark brown. *Pubescence*. Whitish, except light brown to ferruginous on inner surfaces of tarsi. Fore basitarsus with sparse fringe of hairs, about as long as width of basitarsus, along posterior margin. Outer surfaces of fore and middle basitarsi densely covered by dense tomentum (integument not visible among hairs). *Sculpturing*. Propodeal triangle dull or weakly shiny, finely lineolate. T1–T5 with weakly to strongly elevated discal areas, dull or weakly shiny, finely imbricate, with fine, very sparse punctures (4–5× PW); depressed marginal zones with fine punctures as on discs, slightly denser (2–3× PW); distal margins dull or weakly shiny, about one-third width of depressed marginal zone, little differentiated from it, broadest on T1 (slightly narrower than depressed marginal zone).

*Male*. Body length 8.2–12.3 mm; forewing length 6.5–8.3 mm. *Structure*. Labrum with preapical projections absent; F1 1.4× longer than broad, shorter (~0.7×) than combined lengths of F2 and F3. T6 with lateral spine straight or nearly straight, about as long as median spine of T7; lateral lobe of T7 apically rounded, about twice as broad as distance between inner margin and median spine (Fig. 268); S4 with reddish brown apical brush of short hairs on one-quarter of straight distal margin (Fig. 323); S6, in ventral view, with basal margin gently convex, nearly straight, lateral lobe broader than long, obliquely truncate, ventrally bent, median lobe slightly longer than broad, distal margin notched (Fig. 395); S7

hemisternite somewhat apically truncate (Fig. 472); S8 with distinct, long, rectangular apical process, about one-third width of distal margin basally (Fig. 549). Genitalia: gonostylus robust, 3.0× longer than broad, broader at apex, nearly parallel-sided in profile; volsella about one-third of gonostylar length, triangular in ventral view, somewhat rectangular in profile, basally swollen on dorsal margin; penis valve broad, with pointed apex, about half of gonostylar length, dorsoapical patch of hairs present, medial projection large, distinct. *Coloration*. As in female, except yellow on outer surface of mandible, clypeus, inferior paraocular area, anterior surface of scape, and T7, except apex of median spine, lateral and distal margins. *Pubescence*. Longer and denser than in female, especially on face. *Sculpturing*. Terga with punctures slightly finer, sparser than in female.

*Distribution*. USA: Nevada, Utah, Idaho, Colorado, Wyoming (1100–2700 m a.s.l.). Restricted to sand dunes of the Great Basin, Colorado Plateau, Red Desert, the San Luis Valley (Great Sand Dunes), and Roggen, Colorado on the western edge of the Great Plains (Fig. 582).

*Phenology*: May–early September; the period from June through first half of July accounts for 67% of records.

*Floral records*: ASTERACEAE: *Tetradymia tetramers*. FABACEAE: *Psoraleidum lanceolatum*, *Psoraleidum polydenius*.

*Comments*: This species is associated with sand dunes, and can be considered an obligate psammophyte. The female has the long fringe of hairs also found in the coastal dune specialist, *A. palliventris*, but the fringe is shorter and not as stiff. Schwarz (1934) described *A. rodecki* from specimens of both sexes (13 males and one female), but did not designate the type in the original description; however, at the UCM, one of the males from the type series has a type label, whereas the single female has an allotype label. The complete label data for this male specimen that we designate as the lectotype to stabilize the name, are as follows: 'Roggen, Colo, July 17 1930, H.G. Rodeck // TYPE (white label with red letters) // *Anthidium rodecki* Schwarz // UCMC 0000017 // (red label) ♂ Lectotype *Anthidium rodecki* Schwarz Des. V.H. Gonzalez & T. Griswold 2010'.

#### *ANTHIDIUM RODRIGUEZI* COCKERELL, 1912

FEMALE, FIGS 5E, 8, 117, 195; MALE, FIGS 269, 396, 473, 550; MAP, FIG. 582

*Anthidium rodriguezi* Cockerell, 1912: 563–564 (holotype: AMNH; ♂, Guatemala).

*Melanthidium carri* Cockerell, 1947: 106 (holotype: USNM 58430; ♀, Agua Amarilla, Honduras); Michener, 1948: 17 (synonymy).

**Diagnosis:** Both sexes of this species can be distinguished from all other NW *Anthidium*, except *A. chamelense* sp. nov., by their large body size (body length > 13 mm) and mainly black integument. It can be easily separated from *A. chamelense* sp. nov. by the female T6 with lateral spine distinct, and distal margin with broader, shallower median emargination (Fig. 195), and male T6 without lateral spine.

**Description: Female.** Body length 13.1–19.2 mm; forewing length 10.8–14.2 mm. **Structure.** Compound eyes slightly convergent below, nearly parallel-sided; face flat, clypeus with distal margin straight (Figs 5E, 117); mandible elongate, with seven or eight teeth (Fig. 8); labrum with basal protuberances separated by less than width of protuberance, preapical projections absent; F1 2.0× longer than broad, shorter (0.8×) than combined lengths of F2 and F3. Tibial carina present. T6 gently convex, flattened above preapical carina, lateral spine distinct, preapical carina strong, with wide and shallow emargination on nearly median half of margin, about twice as wide as distance between apices of lateral and submedian angles or spines (Fig. 195). **Coloration.** Black, except: dark brown on antennae and tarsi; yellow as follows: medially interrupted band on vertex (sometimes reduced to spot behind compound eye), axilla, and scutellum. Wings brown; veins and stigma dark brown. **Pubescence.** Whitish to cream, darker on clypeus, supraclypeal area, vertex, disc of scutum, coxae, trochanters, inner surfaces of tarsi, discs of basal three terga, and S6 (sternal scopa usually whitish laterally, brownish otherwise). Clypeus, supraclypeal area, and frons covered with simple, stiff, apically curly or hooked hairs, denser on clypeus. Outer surfaces of basitarsi densely covered by tomentum (integument not visible among hairs). **Sculpturing.** Clypeus, supraclypeal area, and frons dull between coarse, sparse (1–2× PW) punctures, integument finely imbricate, punctures smaller, closer on clypeus. Propodeal triangle dull, finely punctate. T1–T5 with weakly elevated discal areas, shiny, weakly imbricate to nearly smooth, between dense punctures (1–2× PW); depressed marginal zones laterally punctate (~1× PW), punctures otherwise sparse or absent; distal margins not differentiated from rest of depressed marginal zone, about as wide as depressed marginal zone laterally.

**Male.** Body length 16.9–21.5 mm; forewing length 13.5–16.6 mm. **Structure.** Face nearly as flat as in female, except clypeus weakly convex; mandible

elongate, with three large, distinct teeth, distance between second and third teeth about twice as long as distance between first and second, upper mandibular interspace sometimes divided in smaller teeth, thus forming six- or seven-toothed mandible; labrum with basal projections nearly absent; F1 1.6× longer than broad, shorter (0.6×) than combined lengths of F2 and F3. Hind coxa ventrally depressed; hind femur with basal tubercle on ventral surface. Lateral spine of T6 reduced to tubercle or absent; T7 with lateral lobe spiniform, stout, about twice as long as median spine, slightly slender, and less curved, in profile view, than in *A. chamelense* sp. nov. (Fig. 269); S4 without apical brush, distal margin straight; S6, in ventral view, with basal margin straight, distal margin strongly reflexed, with distinct, acute lateral and median lobes (Fig. 396); S7 hemisternite somewhat narrowly projected distally (Fig. 473); S8 elongate (2.6× longer than broad), with apical process as broad as long, weakly bifid distally (Fig. 550). Genitalia: gonostylus slender, 5.0× longer than broad, nearly straight, ventrally flattened; volsella about one-third of gonostylar length, digitiform (in profile view), ventrally curved, about as wide as apex of penis valve; penis valve about half of gonostylar length, apically curved, with large dorsolateral projection (better seen in profile view, slightly broader than in *A. chamelense* sp. nov.), dorsoapical patch of hairs present, medial projection distinct. **Coloration.** As in female, except yellow on outer surface of mandible, clypeus, except U- or W-shaped spot on distal two-thirds, inferior paraocular area, pronotal lobe, anterolateral and lateral margins of scutum (usually reduced or absent), anterior margin of middle tibia distally, outer surfaces of basitarsi, and T1, with small lateral spot. **Pubescence.** Ventral surfaces of mesepisternum and metepisternum, and base of hind coxa, densely covered by short, stout, simple, dark-brown hairs. **Sculpturing.** As in female (including modified integument of face), except for clypeus and discal areas of T1–T6 more densely and finely punctate.

**Distribution:** HONDURAS, GUATEMALA, MEXICO: Chiapas to Sinaloa, Nuevo Leon, Tamaulipas (100–2200 m a.s.l.). Occurs in dry forest (67% of records), pine–oak forest, and Veracruz moist forest ecosystems (Fig. 582).

**Phenology:** June–early December; one record from March; majority of records (72%) from October and first half November.

**Floral records:** ASTERACEAE: *Bidens* sp. LAMIACEAE: *Salvia leptostachys*, *Salvia melissodora*.

*Comments:* The type of *Melanthidium carri* is a female, not a male as indicated in the original description.

*ANTHIDIUM ROZENI* URBAN, 2001

MALE, FIGS 270, 397, 474, 551

*Anthidium rozeni* Urban, 2001b: 547 (holotype: DZUP♂; Canta, Lima, Peru).

*Diagnosis:* This species, only known from the male (but see comments below), resembles *A. weyrauchi* in the S4 without apical brush and S6 with deep median emargination on distal margin (Fig. 397). It can be separated from *A. weyrauchi* by the T7 with lateral lobe nearly parallel-sided, apically rounded (Fig. 270), S8 with apical process bifid (Fig. 551), and wings translucent, slightly brownish. In *A. weyrauchi* the lateral lobe of T7 is gently curved apically, the apical process of S8 is simple, and the wings are distinctly dark brown, with weak blue and violet reflections.

*Description: Male.* Body length 10.0 mm. *Structure.* F1 1.6× longer than broad, shorter (0.7×) than combined lengths of F2 and F3. Tibial carina absent. Lateral spine of T6 straight or nearly straight, about as long as median spine of T7; lateral lobe of T7 nearly parallel-sided, apically rounded, about as wide as distance between inner margin and median spine (Fig. 270); S4 without apical hair brush, distal margin gently concave; S6, in ventral view, with straight basal margin, lateral spine short, blunt, distal margin with deep median emargination, about twice as broad as deep (Fig. 397); S7 hemisternite as in Figure 474; S8 with weakly bifid apical process, about one-third width of distal margin basally (Fig. 551). Genitalia: gonostylus robust, 3.0× longer than broad, broadest at apex in profile; volsella small, less than one-third of gonostylar length, subtriangular in ventral view; penis valve about as long as gonostylus, with small dorsoapical projection on median margin, laterally compressed, apically curved, medial projection large, distinct. *Coloration.* Dark brown to black, except ferruginous on tegula and legs, excluding coxa to basal half of femur of foreleg; yellow as follows: clypeus, except for distal margin, inferior paraocular area, rounded to oval spot laterally on vertex, T1–T4 with medially interrupted bands, laterally deeply notched on posterior margin, and T5 with complete band, medially notched on anterior margin, laterally deeply notched on posterior margin. Wings light orange basally, brownish distally; veins ferruginous basally, dark brown distally, including stigma. *Pubescence.* Whitish, except brownish to light ferruginous hairs on inner surfaces of tarsi, T3–T6, and sides of sterna. *Sculpturing.* Propodeal triangle weakly shiny, finely

lineolate to imbricate. T1–T5 with weakly elevated discal areas, shiny, weakly lineolate to imbricate between punctures (2–4× PW); depressed marginal zones with punctures slightly denser than on discs (1–2× PW); distal margins about 2–3× PW.

*Distribution:* PERU: Lima (2800 m a.s.l.). Known only from the type locality in the Sechura Desert ecoregion.

*Phenology:* May.

*Comments:* As indicated by Urban (2001b), the right eye of the holotype is destroyed. Urban (2002: 510) described a female from Canta, Peru, that we were not able to examine. The following notes were extracted from Urban's description and illustration: body length 9.2 mm. Clypeal margin simple, non tuberculate, gently convex medially; T6 without distinct lateral projection, with depressed apical rim on median one-third of nearly truncate distal margin. Body black, except for the tegula, bases of wings, and most of legs ferruginous; the following areas yellow: vertex, above compound eyes, with oval spots, T1–T4 with medially interrupted bands, laterally notched on posterior margins, T5 with complete band, medially notched on anterior margin, and laterally notched on posterior margin. Pubescence whitish, including sternal scopa; outer surface of basitarsus of all legs without tomentum. Based on these characters, the female of *A. rozeni* would run to *A. gayi* in our key. Although it could be separated by the shape of T6 (the lateral angles are projecting into small, acute spines in *A. gayi*), we decided not to include this species in the key pending confirmation of the identity of this female.

*ANTHIDIUM RUBRIPES* FRIESE, 1908

FEMALE, FIGS 2, 118, 196; MALE, FIGS 271, 324, 398, 475, 552; MAP, FIG. 583

*Anthidium rubripes* Friese, 1908: 70 (lectotype: ZMB; ♂, Tucuman, Argentina) (**new lectotype designation**).

*Anthidium boliviense* Friese, 1920: 54 (lectotype: ZMB; ♀, Mapiri, Bolivia); Urban, 2002: 511 (synonymy with *rubripes*) (**new lectotype designation**).

*Anthidium kuscheli* Moure, 1957: 213 (lectotype: DZUP; ♂; Poroma, Chile); Urban, 2001a: 269 (type designation); Urban, 2002: 511 (synonymy with *rubripes*).

*Diagnosis:* Both sexes of this species are most similar to those of *A. adriani* and *A. sparsipunctatum* sp. nov., in the absence of a tibial carina, coloration pattern (i.e. antenna, tegula, legs, and base of wings



ferruginous, and T1–T4 with interrupted yellow or cream bands), and shape of female T6, and male T7 and S6. Both sexes lack the ferruginous pubescence on the head and metasoma found in *A. adriani*, and differ from *A. sparsipunctatum* sp. nov. in the scutum and scutellum with dull or weakly shiny integument and contiguous punctures. Females can further be distinguished by the labrum with small but distinct preapical projections, and males by the combination of T1–T3 with narrowly interrupted bands and S6 with straight apical margin. Superficially, *A. rubripes* also resembles *A. anurospilum*, *A. danunciae* sp. nov., *A. mapuche* sp. nov., and coloured forms of *A. decaspilum* in the sternal scopa black and the body colour. It can be easily separated from those species by the following combination of characters: female hind basitarsus with unmodified hairs on the outer surface (about the same length and thickness as those on anterior margin); head and mesosoma with mostly black, grey, or pale hairs, not predominantly ferruginous; scutum and scutellum dull with contiguous punctures; T1–T3 usually with narrowly interrupted bands, gap between bands much less than length of lateral bands; female T6 gently convex, with lateral spine small, acute, and with depressed apical rim projecting on about half of gently convex distal margin (Fig. 196); and small body size (8–13 mm in body length).

**Description: Female.** Body length 8.0–10.5 mm; forewing length 7.2–9.4 mm. **Structure.** Clypeus weakly convex, projected about 0.4× width of compound eye in profile, distal margin rather thin, wavy to gently tuberculate, usually sublaterally projected (Fig. 118); mandible with six or seven teeth; labrum with small basal protuberances separated by a protuberance width, preapical projections small, tuberculiform; F1 about twice as long as broad, shorter (~0.9×) than combined lengths of F2 and F3. Tibial carina absent. T6 gently convex basally, with small, acute lateral spine, preapical carina minutely crenulate, depressed apical rim on about one-half of gently convex distal margin, usually projecting as a rectangular rim (Fig. 196). **Coloration.** Black, except ferruginous on antenna (darker on distal flagellomeres), pronotal lobe (sometimes darkened), tegula, distal two-thirds of femora and remaining segments of legs; cream or yellow as follows: oval spot laterally on vertex (rarely with band across vertex), and T1–T5 with medially interrupted bands, closer on apical terga. Wings light orange basally, brownish distally; veins ferruginous basally (including stigma and prestigma), dark brown distally. **Pubescence.** Dark brown to black, except yellowish to ferruginous hairs on scape, pronotal lobe, and ferruginous areas of legs; whitish to greyish hairs on dorsum of mesosoma, mesepisternum, metepisternum,

sides of propodeum, and sides of T1. Fore basitarsus with sparse fringe of long hairs ( $\geq 2\times$  basitarsal width) along posterior margin. **Sculpturing.** Propodeal triangle weakly shiny, finely lineolate to imbricate. T1–T5 with weakly elevated discal areas, nearly glossy, smooth, shiny between sparse punctures (2–4× PW); depressed marginal zones more densely punctate than on discs (1–2× PW); distal margins smooth, shiny, about one-quarter width of depressed marginal zone.

**Male.** Body length 9.7–12.5 mm; forewing length 7.4–9.2 mm. **Structure.** Labrum without basal and preapical projections; F1 1.9× longer than broad, shorter (0.8×) than combined lengths of F2 and F3. Lateral spine of T6 gently curved to nearly straight, about as long as median spine of T7; lateral lobe of T7 subrectangular, slightly wider than distance between inner margin and median spine, outer margin nearly straight, inner margin angled (Fig. 271); S4 with dense, black hair brush on median one-eighth of straight distal margin (Fig. 324); S6, in ventral view, with gently convex basal margin, laterally with small, sharp, ventrally directed angle, distal margin gently sinuous to nearly straight; S7 hemisternite as in Figure 475; S8 with short, curved, simple apical process, basally broad, about one-third width of distal margin (Fig. 552). Genitalia: gonostylus about 3.0× longer than broad; volsella small, about one-third of gonostylar length, elongate, somewhat digitiform, ventrally curved in profile; penis valve about as long as gonostylus, long, apically narrow, pointed, blade-like, dorsoapical patch of hairs absent, medial projection large, distinct. **Coloration.** As in female, except lateral bands on T1–T5 more widely separated, slightly notched on posterior margin, and yellow or cream on outer surface of mandible, clypeus, and inferior paraocular area. **Pubescence.** As in female, except whitish or yellowish hairs on head and mesosoma (excluding ferruginous areas).

**Distribution:** PERU: Moquegua; ARGENTINA: from Salta to Mendoza. BOLIVIA: La Paz. CHILE: from Arica and Parinacota to Aisen (400–4200 m a.s.l.). Recorded from the Sechura Desert, Central Andean and Central Andean dry puna, Southern Andean and Patagonian steppe, High and Low Monte, and Valdivian temperate forest ecoregions (Fig. 583).

**Phenology:** September–April.

**Floral records:** FABACEAE: *Adesmia* sp.; *Medicago sativa*.

**Comments:** Friese (1908) described *A. rubripes* based on both males and females from Mendoza, Salta, and Tucumán in Argentina. We examined two male

specimens from the ZMB, both in good condition, one from Tucumán, with a red 'type' label, and one from Mendoza, with an orange 'type' label. To stabilize the name we chose the red 'type' labelled specimen as the lectotype because red 'type' labelled specimens were usually intended by Friese as primary types, and T7 of this specimen is somewhat angulate on its inner margin, as in most specimens from northern Argentina. The label data for this specimen are as follows: 'Argentina, Tucuman, 28-11-06 (November 28, 1906) // *Anthidium rubripes* ♂ 1907 Friese det. // Type (red label) // Zool. Mus. Berlin // Lectotype *Anthidium rubripes* Friese ♂ Des. V.H. Gonzalez & T. Griswold 2010'.

Friese (1920) described *A. boliviense* from the female, and did not mention the number of specimens used in his description; thus, to stabilize the name, we follow Rasmussen & Ascher (2008) in regarding as a syntype a female specimen with a red 'type' label deposited at the ZMB. The label data for this specimen herein designated as lectotype are as follows: 'Bolivia, Mapiri, 1900 // *Anthidium boliviense* ♀ 1913 Friese det. // Type (red label) // Zool. Mus. Berlin // Lectotype *Anthidium boliviense* Friese ♀ Det. V.H. Gonzalez & T. Griswold 2010'.

#### *ANTHIDIUM SANGUINICAUDUM* SCHWARZ, 1933

FEMALE, FIGS 119, 197; MALE, FIGS 272, 325, 399, 476, 553

*Anthidium sanguinicaudum* Schwarz, 1933: 8 (holotype: BNHM; ♂, Mamatoco, Santa Marta, Colombia).

*Anthidium loboguerrero* Urban, 2004: 492 (holotype: DZUP; ♂, Lobo Guerrero, Valle, Colombia) (**new synonym**).

**Diagnosis:** This species is most similar to *A. macushi* sp. nov., sharing almost identical shape of female T6 (Fig. 197) and male genitalia (cf. Fig. 48), and associated sterna (Figs 325, 476, 553). It can be separated from that species by the female clypeus covered with minutely branched hairs, and usually with distal margin wavy or gently tuberculate, and male S6 with small, ventrally directed spine on the distal margin (Fig. 399).

**Description: Female.** Body length 8.5–10.3 mm; forewing length 6.6–7.1 mm. **Structure.** Clypeus prominently convex, projected about 0.4–0.5× width of compound eye, distal margin usually gently tuberculate (Fig. 119); mandible with six or seven teeth; labrum gently tuberculate basally, preapical projections absent, barely indicated by elevated border on lateral margin of furrow; F1 1.7× longer than broad, slightly shorter (~0.8×) than combined lengths of F2 and F3. Tibial carina present. T6 straight in profile,

with small but distinct lateral spine, depressed apical rim projecting on nearly entire convex distal margin (Fig. 197). **Coloration.** Black, except light ferruginous to dark-reddish brown on antenna, tegula, legs, and sterna; yellow as follows: outer surface of mandible, distal half of clypeus, except medially (sometimes broadly interrupted), inferior paraocular area, anterior surface of scape (sometimes reduced), short band or rounded to oval spot laterally on vertex (sometimes reduced), pronotal lobe (sometimes absent), anterior margin of tegula, anterolateral and lateral margins of scutum with continuous broad band (sometimes reduced), axilla (sometimes reduced or absent), distal margin of scutellum, outer surfaces of tibiae (usually with broad band ending before apex), T1–T3 with variable maculations (complete or medially interrupted bands or each with four spots), T4 and T5 with complete bands, and T6 entirely, except lateral and distal margins. Wings hyaline, slightly brownish; veins and stigma dark brown. **Pubescence.** Whitish, except light ferruginous hairs on vertex, pronotal lobe, dorsum of mesosoma, inner surface of tarsi, disc of terga, and S6; dark-brown hairs on depressed marginal zones of terga. Outer surface of basitarsi densely covered by tomentum (integument not visible between hairs). **Sculpturing.** Propodeal triangle minutely punctate, dull. T1–T5 with weakly elevated discal areas, dull, weakly imbricate between dense punctures (1–2× PW); depressed marginal zones slightly more densely punctate than on discs ( $\leq 1\times$  PW); distal margins dull, narrow (2–3× PW), narrowest on T5 ( $\leq 1\times$  PW).

**Male.** Body length 8.9–11.5 mm; forewing length 6.3–8.0 mm. **Structure.** F1 1.6× longer than broad, shorter (0.8×) than combined lengths of F2 and F3. Lateral spine of T6 straight, about as long as median spine of T7; lateral lobe of T7 broadly rounded, more than twice as broad as distance between inner margin and median spine, outer margin strongly convex, inner margin straight (Fig. 272); S4 without distinct apical brush, with single row of thick, dark-reddish brown hairs on one-fifth of gently concave distal margin (Fig. 325); S6, in ventral view, with gently convex basal margin, laterally with blunt, ventrolaterally directed spine, distal margin projected, medially truncate, with small, ventrally directed spine (Fig. 399); S7 hemisternite rounded, somewhat truncate distally (Fig. 476); S8 with apical process broadly expanded distally, about half width of distal margin, medially ending in small bifid projection (Fig. 553). Genitalia: gonostylus robust, about 3.8× longer than broad; volsella large, about half of gonostylar length, apically rounded, dorsally with small basal projection; penis valve about as long as gonostylus, apically narrow, blade-like, pointed, dorsally with small lateral and medial projections, dorsoapical patch of

hairs absent, medial projection large, distinct. *Coloration*. As in female, except yellow on clypeus, anterior surface of scape, and outer surfaces of tibiae, basitarsi, and T1, with large lateral spot (usually absent); maculations on scutum usually reduced, and T3–T5 sometimes deeply notched laterally on anterior margin. *Sculpturing*. Terga slightly shinier, with broader distal margins than in female, about one-third to one-half width of depressed marginal zone.

*Distribution*. COLOMBIA: Valle, Antioquia, Huila. VENEZUELA: Sucre, Zulia. SURINAME: Wanica, Lelydrop (100–900 m a.s.l.). Recorded from the Cauca Valley and Magdalena Valley dry forest, Northwestern Andean montane forest, Araya and Paria xeric scrub, and Llanos ecoregions.

*Phenology*: August, October, December, January.

*Comments*: *Anthidium loboguerrero* was based on two specimens (one of each sex) of *A. sanguinicaudum*, with reduced yellow markings (Urban, 2004). Colour variants in *Anthidium* are not uncommon, and sometimes occur even within the same locality. In addition to the reduced maculations, Colombian specimens of *A. sanguinicaudum* also vary in the clypeal margin of the female and the apical brush of S4 in the male. The clypeal margin is usually black, but in some specimens from the Magdalena Valley (Departments of Tolima and Huila) it is translucent. Likewise, the apical brush of S4 in some males from Santa Fe (Antioquia) and Dagua (Valle) is sparser, with only a single row of thick hairs, as opposed to being composed of several rows, as in the males from other localities. Despite these variations, we did not find consistent differences in the shape of T6 of the female, and T7, S6–S8, and genitalia of the male.

#### *ANTHIDIUM SCHWARZI* SP. NOV.

FEMALE, FIGS 31, 120; MALE, FIGS 273, 326, 400, 477, 554, 574; MAP, FIG. 582

*Diagnosis*: The female of this species is most similar to *A. palmarum* in the outer surfaces of basitarsi densely covered by tomentum, and T6 with a depressed apical rim laterally projecting into a distinct submedian lobe. It can be separated from that species by the T6 with lateral spine distinct (Fig. 31), and the face and mandibles usually without yellow markings (Fig. 120). The male is easily separated from that species by the following combination of characters: T7 with lateral lobe elongate, narrowly rounded (Fig. 273); S4 with apical brush consisting of long, black hairs on the deeply concave distal margin (Fig. 326); S7 hemisternite with distal margin concave (Fig. 477); and S8 with apical process

strongly curved in profile, with apex distinctly broad, diamond-shaped (Fig. 554).

*Description (paratypes in parentheses): Female*. Body length 10.5 mm (9.1–11.5); forewing length 8.2 mm (6.5–8.5). *Structure*. Clypeus prominently convex, projected about 0.4× width of compound eye in profile, distal margin thin, wavy, two lateralmost tubercles distinctly projected (Fig. 120); mandible with five or six teeth; labrum without basal protuberances, preapical projections large, distinctly curved upwards; F1 1.8× longer than broad, slightly shorter (0.9×) than combined lengths of F2 and F3. Tibial carina absent. T6 distinctly convex in profile, preapical carina absent, lateral spine strong, distinct, depressed apical rim laterally projecting into distinct submedian lobe, median emargination small (Fig. 31). *Coloration*. Dark brown to black, except light brown to ferruginous on tarsi; yellow maculations as follows: (small rounded spot on apicolateral area of clypeus and inferior paraocular area), oval spot (1.0–1.5× OD) laterally on vertex, pronotal lobe, (thin band on lateral margin of scutum, next to tegula), tegula, except at centre, distal margin of scutellum, except medially, outer surfaces of tibiae, T1–T5 with medially interrupted bands, closer on apical terga, laterally deeply notched on anterior margin. Wings hyaline, slightly brownish; veins and stigma dark brown. *Pubescence*. Whitish (yellowish in some paratypes), except brownish hairs on outer surface of middle tibia distally, inner surfaces of tarsi, and sterna, except S1, and sides of remaining sterna. Outer surface of basitarsi densely covered by tomentum (integument not visible among hairs). *Sculpturing*. Propodeal triangle weakly lineolate, weakly shiny (nearly smooth and distinctly shiny in some paratypes). T1–T5 with weakly elevated discal areas, dull or weakly shiny, weakly imbricate between punctures (2–4× PW); depressed marginal zones with denser punctures than on discs (1–2× PW); distal margins little or no differentiated from depressed marginal zone, dull, narrow (1–2× PW), broadest on T1.

*Male*. Body length 11.5–14.3 mm; forewing length 7.5–9.8 mm. *Structure*. Labrum with preapical projections larger than in female; F1 1.6× longer than broad, shorter (0.8×) than combined lengths of F2 and F3. Lateral spine of T6 straight or nearly straight, about as long as median spine of T7; lateral lobe of T7 elongate, apically rounded, about twice as wide as distance between inner margin and median spine (Fig. 273); S4 with apical brush of long, black hairs on deeply concave distal margin (Fig. 326); S6, in ventral view, with basal margin straight, lateral lobe short, broad, median lobe subrectangular, apically notched (Fig. 400); S7 hemisternite distinctly concave



on distal margin (Fig. 477); S8 with apical process broad at apex, diamond-shaped, strongly curved in profile, basally about one-third width of distal margin (Fig. 554). Genitalia: gonostylus robust, 3.8× longer than broad; volsella small, about one-third of gonostylar length, triangular in ventral view, somewhat truncate in profile; penis valve about half of gonostylar length, apically broad, flattened, dorsoapical patch of hairs present, medial projection small (Fig. 574). *Coloration*. As in female, except yellow maculations as follows: outer surface of mandible, clypeus, inferior paraocular area, ventrolateral surface of hind coxa (usually reduced or absent), outer surfaces of fore and middle tibiae distally (sometimes absent), basitarsi, and small submedian spot on T6 (sometimes absent); maculation on distal margin of scutellum usually absent. *Pubescence*. Lighter than in female, including on legs and sterna. *Sculpturing*. Terga shinier, with finer punctures than in female.

*Holotype*: ♀, USA Texas, Culberson Co., 60 km N Van Horn, 9-IV-86, T. Griswold // on *Phacelia* (BBSL).

*Paratype*: 43 females, 32 males. USA: Arizona, Apache Co., 1♀, Jct. Hwy 4 & Hwy 191, 4 Jun 1997, *Sphaeralcea*, G. Trostle, D.F. Veirs; Nevada, Clark Co., 1♂, Kyle Canyon, 28 May 1998, F.D. Parker; New Mexico, Otero Co., 1♂, Alamogordo, 5 mi N, 24 Apr 1960, Richards; Socorro Co., 1♀, Sevilleta National Wildlife Refuge, 28 Apr 2003, *Dalea*, P.F. Torchio; 1♀, Sevilleta National Wildlife Refuge, 28 Apr 2003, *Phacelia distans*, P.F. Torchio; 1♂, Sevilleta NWR-5 Pts Grass-GIS, 1 May 2001, K. Wetherill; 1♂, Sevilleta NWR-B, 18 May 2004, *Phacelia integrifolia*, K. Wetherill; Torrance Co., 1♀, Corona, 3 mi NE, 6 Jun 1977, Knowlton, Hanson; Texas, Brewster Co., 1♂, 2♀, Big Bend National Park, Cooper's Store, 11 Apr 1949, *Phacelia popei*, Beamer, C.D. Michener; 2♂, Big Bend National Park, Cooper's Store, 4 Apr 1949, *Phacelia popei*, Beamer, C.D. Michener; Crane Co., 4♂, 4♀, Crane, 10 Apr 1954, *Phacelia*, R.H. Beamer; Culberson Co., 13♂, 13♀, same data as holotype; 3♂, 7♀, same data as holotype, except R. Griswold, no floral record; Ector Co., 1♂, Odessa, 9 Apr 1954, *Phacelia*, L.D. Beamer; 1♀, Odessa, 9 Apr 1954, *Phacelia*, R.H. Beamer; Mitchell Co., 1♀, Westbrook, 7 Apr 1954, *Gaillardia suavis*, R.H. Beamer; Pecos Co., 1♀, Imperial, 10 Apr 1954, *Phacelia popei*, R.H. Beamer; 2♀, Pecos, 15 May 1927, J.O. Martin; Presidio Co., 1♂, Marfa, 28 Apr 1942, A.L. Melander; 2♀, Valentine, 6 mi SW, 1300 m a.s.l., 20 May 2005, J.L. Neff, A. Hook; 3♀, Valentine, 6 mi SW, 1300 m a.s.l., 20 May 2005, *Nama hispidum*, J.L. Neff, A. Hook; 2♀, Valentine, 6 mi SW, 1300 m a.s.l., 20 May 2005, *Phacelia crenulata*, J.L. Neff, A. Hook; Reeves Co., 2♂, 2♀, Balmorhea, 1 May 1954, *Phacelia* sp., R.H. Beamer; 1♂, 1♀,

Toyahvale, 1.5 mi S, Hwy 17, 25 Apr 1979, R.R. Snelling; Upton Co., 1♂, McCamey, 16 Apr 1949, Beamer, C.D. Michener; Utah, Kane Co., 1♀, Billy Pasture, 0.4 mi N, 26 Jun 2003, *Phacelia alba*, H. Ikerd; 1♀, Dry Fork, 1450.87, 4 Jun 2003, *Stephanomeria exigua*, J.S. Wilson; Millard Co., 1♂, Pine Valley, International Biological Program Site, 1986, 6 Jun 1973, *Phacelia corrugata*; Salt Lake Co., 1♀, S of South Salt Lake, 1319–2331, 1319–2414, 2 Jul 2008, D. Downey; Tooele Co., 1♂, Dugway Proving Grounds, Wig Mtn, 4.5 km NE (site 8), 3 Jun 1997, T. Toler (BBSL, BNHM, BYUC, CAS, CTMI, LACM, SEMC, UCDC).

*Distribution*: USA: northern Arizona, southern Nevada, New Mexico, western Texas, Utah. MEXICO: Sonora (700–2500 m a.s.l.). Predominately Chihuahuan Desert (70% of records), southern portion of the Colorado Plateau shrublands, and Western short grasslands ecoregions; rare in Great Basin and eastern Mojave Desert (Fig. 582).

*Phenology*: April–early July; a single record from 4 September; April and May account for 88% of records.

*Floral records*: ASTERACEAE: *Gaillardia suavis*, *Senecio ligulifolius*, *Stephanomeria exigua*. BORAGINACEAE: *Nama hispidum*, *Phacelia alba*, *Phacelia crenulata*, *Phacelia corrugata*, *Phacelia distans*, *Phacelia integrifolia*, *Phacelia popei*, *Phacelia* sp. FABACEAE: *Dalea* sp. MALVACEAE: *Sphaeralcea* sp. *Anthidium schwarzi* sp. nov. may be a *Phacelia* specialist, 92% of floral associations were with this plant genus.

*Etymology*: The name of this species is a patronym honoring the distinguished American bee specialist Herbert F. Schwarz (1883–1960). The novelty of this species was recognized by Dr Wallace E. LaBerge, who intended to name it after Schwarz. We have retained this designation.

*ANTHIDIUM SERTANICOLA* MOURE & URBAN, 1964  
FEMALE, FIGS 121, 198; MALE, FIGS 274, 327, 401,  
478, 555

*Anthidium sertanicola* Moure & Urban, 1964: 102 (holotype: DZUP; ♂, Passos, Minas Gerais, Brazil).

*Diagnosis*: The female of this species is easily recognized by the following combination of characters: clypeus weakly convex, with distal margin strongly tuberculate (Fig. 121); hind tibia with carina; basitarsi without tomentum on the outer surfaces; and T6 without distinct lateral spine, with depressed apical rim laterally projecting into a distinct lobe or angle

(visible in dorsal view) (Fig. 198). The male can be recognized by the following combination of characters: T7 apically narrowed, with lateral lobe spiniform and median spine reduced (Fig. 274); S4 with apical brush small, consisting of two distinct reddish brown brushes (Fig. 327); and S6 with lateral spine short, pointed, anteriorly directed, and distal margin medially projected, with a small, ventrally oriented median spine (Fig. 401). The two small spines on the ventral surface of the metepisternum in the male are unique.

*Description: Female.* Body length 10.0–10.8 mm; forewing length 8.5–8.8 mm. *Structure.* Clypeus weakly convex, projected about 0.3× width of compound eye in profile, distal margin strongly tuberculate (Fig. 121); mandible with six teeth; labrum with low basal tubercles, preapical projections small, pointed; F1 about twice as long as broad, slightly shorter (0.7×) than combined lengths of F2 and F3. Preoccipital border sharp, not distinctly carinate. Tibial carina present. T6 straight in profile, without distinct lateral spine, preapical carina strong, partially covering depressed apical rim in dorsal view, depressed apical rim visible on entire distal margin, laterally projecting into distinct lobe or angle (visible in dorsal view), median emargination small (Fig. 198). *Coloration.* Black, except ferruginous on antenna (apical segments sometimes darkened), tegula, legs, excluding coxae and bases of trochanters, and basal two sterna; yellow maculations as follows: outer surface of mandible, clypeus, except black spot basally, inferior paraocular area, band on vertex and upper portion of gena, pronotal lobe, anterolateral and lateral margins of scutum with continuous band, axilla, distal margin of scutellum, inferior margin of middle femur distally, outer surfaces of tibiae, basitarsi (usually yellowish), T1–T3 with thin lateral bands, remaining terga with small submedian spots. Wings subhyaline, dark brown; veins and stigma dark brown. *Pubescence.* Whitish, except ferruginous hairs on face, vertex, dorsum of mesosoma, pronotal lobe, upper portions of mesepisternum, metepisternum, and propodeum, and inner surfaces of tarsi. *Sculpturing.* Propodeal triangle dull, finely imbricate. T1–T5 with weakly elevated discal areas, dull or weakly shiny, weakly imbricate between punctures (1–3× PW); depressed marginal zones slightly more densely punctate than on discs (1–3× PW); distal margins dull, narrow (2–3× PW), broadest on T1.

*Male.* Body length 14.6 mm; forewing length 8.4 mm. *Structure.* F1 about twice as long as broad, shorter (0.8×) than combined lengths of F2 and F3; labrum with basal protuberances stronger than in female, separated by width of protuberance, preapical projections absent. Ventral surface of metepisternum

with two small, pointed spines just above bases of hind coxae. Lateral spine of T6 gently curved, pointed, apically about as wide as apex of lateral lobe of T7; T7 apically narrowed, lateral lobe spiniform, median spine reduced, barely indicated by tubercle (Fig. 274); S4 with apical brush of short, stout, reddish brown hairs on median one-fifth of gently concave distal margin (Fig. 327); S6, in ventral view, with gently convex basal margin, lateral spine small, pointed, anteriorly directed, distal margin medially projected, with small, ventrally oriented median spine (Fig. 401); S7 hemisternite as in Figure 478; S8 with apical process short, broader than long, basally about one-quarter width of distal margin (Fig. 555). Genitalia: much broader than long, gonobase short, gonostylus about 3.0× longer than broad, laterally compressed, about same width across length, apically curved; volsella reduced or absent, barely indicated by elevated ridge; penis valve about 2.0× gonostylar length, apically broad, flattened, bifid (lobes long, narrow), dorsoapical patch of hairs absent, medial projection large, distinct. *Coloration.* As in female, except yellowish on anterior surface of scape and basitarsi; ferruginous on sterna; T4 with lateral band, and T7 with large lateral spot. *Sculpturing.* Terga not as coarsely punctate, with narrower distal margins than in female.

*Distribution:* BRAZIL: Mato Grosso, Minas Gerais, São Paulo. PARAGUAY: Itapúa (200–700 m a.s.l.). Recorded from the Cerrado ecoregion.

*Phenology:* February, September.

#### *ANTHIDIUM SONORENSE* COCKERELL, 1923

FEMALE, FIGS 10, 122, 199; MALE, FIGS 275, 328, 402, 479, 556; MAP, FIG. 582

*Anthidium sonorensis* Cockerell, 1923: 91 (holotype: CAS 952; ♂, Guaymas, Sonora, Mexico).

*Anthidium sonorensis productum* Cockerell, 1923: 92 (holotype: CAS 953; ♀, San José Island, Gulf of California, Mexico); Grigarick & Stange, 1968: 32 (synonymy with *sonorensis*).

*Anthidium rohweri* Schwarz, 1927b: 7 (holotype: USNM 40162; ♂, Sacatan, Arizona, USA); Grigarick & Stange, 1968: 32 (synonymy with *sonorensis*).

*Diagnosis:* This species is most similar to *A. paroselae*, sharing the tibial carina (often weak), frons shiny, clypeus weakly convex with apical margin smooth, and terga weakly raised on discs. It differs from that species in the shape of the apical mandibular tooth (compare Figs 9 and 10) and the distal margin of T6 in the female (compare Figs 185 and 199), and T7, S6, and S7 of the male. In addition, the female of

*A. sonorensis* typically has two longitudinal submedian yellow bands on the disc of the scutum; such bands are absent in *A. paroselae*. Males of this species appear twice in the key because the tibial carina is sometimes weak to nearly absent.

**Description: Female.** Body length 9.2–12.3 mm; forewing length 6.9–8.2 mm. **Structure.** Clypeus gently convex, projected about 0.4× width of compound eye in profile, distal margin thin, straight (Fig. 122); mandible with five or six teeth, apical tooth parallel-sided, much broader, longer than remaining teeth (Fig. 10); labrum without basal protuberances, preapical projections absent; F1 1.8× longer than broad, shorter (~0.8×) than combined lengths of F2 and F3. Tibial carina present, sometimes weak. T6 straight or nearly straight in profile, preapical carina translucent, minutely crenulate, depressed apical rim distinctly projecting on median one-third of distal margin (Fig. 199). **Coloration.** Black, except: brownish on antennal flagellum, disc of tegula, coxae to tibiae of all legs, tarsi, and sterna; yellow as follows: outer surface of mandible, clypeus, except distal margin, inferior paraocular area, anterior surface of scape (usually reduced), medially interrupted band on vertex, pronotal lobe, tegula, except on disc, anterolateral and lateral margins of scutum with continuous band, disc of scutum with two narrow longitudinal submedian bands (sometimes absent), axilla, distal margin of scutellum, propodeum with two small spots below triangle, ventral surfaces of coxae (usually with small spots), inferior margins of femora distally (usually also on superior margins), outer surfaces of tibia and basitarsi, T1–T5 with nearly complete bands, deeply notched medially, T6 entirely, and sides of sterna. Wings hyaline; veins and stigma dark brown. **Pubescence.** Whitish. Outer surfaces of tibiae, particularly on apices of fore and middle tibiae, and on hind tibia densely covered by tomentum. Outer surfaces basitarsi sparsely covered by tomentum (integument barely visible among hairs). **Sculpturing.** Propodeal triangle dull or weakly shiny, finely imbricate. T1–T5 with weakly elevated discal areas, dull or weakly shiny, finely imbricate, with fine, sparse punctures (2–3× PW); depressed marginal zones with fine punctures as on discs, but slightly denser (1–2× PW); distal margins dull or weakly shiny, narrow (2–3× PW), little differentiated from rest of depressed marginal zone.

**Male.** Body length 11.0–12.3 mm; forewing length 7.8–8.0 mm. **Structure.** F1 1.7× longer than broad, shorter (~0.7×) than combined lengths of F2 and F3. Lateral spine of T6 nearly straight, about as long as median spine of T7; lateral lobe of T7 triangular, basally about as broad as distance between inner margin and median spine (Fig. 275); S4 with small

(about one-seventh sternal width), reddish brown apical brush on straight distal margin (Fig. 328); S6, in ventral view, with basal margin gently convex to nearly straight, laterally with small, ventrally directed acute spine, distal margin medially projected, with anteriorly curved spine (Fig. 402); S7 hemisternite as in Figure 479; S8 with short, broad apical process, weakly notched distally, basally about one-third width of distal margin (Fig. 556). Genitalia: gonostylus slender, 5.0× longer than broad, nearly parallel-sided in profile, apex slightly curved, pointed; volsella large, about two-thirds of gonostylar length, about as long as penis valve, digitiform, basally enlarged on dorsal margin; penis valve about two-thirds of gonostylar length, apically broad, flat, lateral margin with distinctly dorsally bent lobe (better seen in profile), dorsoapical patch of hairs reduced or absent, medial projection large, distinct. **Coloration.** As in female, except terga with bands medially and laterally more deeply notched. **Pubescence.** Longer and denser than in female, especially on face. **Sculpturing.** Terga shinier, with finer, sparser punctures than in female; distal margins broad, about as broad as depressed marginal zone (narrower on T1 and T2).

**Distribution:** USA: southern California. MEXICO: Baja California Sur, Baja California, Sonora (from ~80 to 800 m a.s.l., below sea level records are from Death Valley and Imperial Valley). Sonoran and Mojave Deserts; absent from the Chihuahuan Desert. This is the only *Anthidium* where a large proportion of the records (48%) are from sites that are below sea level. May be locally abundant in the spring on *Larrea* (Hurd & Linsley, 1975) (Fig. 582).

**Phenology:** April–June; two records from September; majority of records (84%) from April and May.

**Floral records:** AIZOACEAE: *Sesuvium verrucosum*. FABACEAE: *Dalea spinosa*; *Prosopis* sp. ZYGOPHYLLACEAE: *Larrea divaricata*, *Larrea tridentata*.

#### **ANTHIDIUM SPARSIPUNCTATUM SP. NOV.**

FEMALE, FIG. 6B; MAP, FIG. 583

**Diagnosis:** Both sexes of this species are most similar to those of *A. adriani* and *A. rubripes* (see above). It can be easily separated from those species by the scutum and scutellum distinctly smooth and shiny between scattered, not contiguous punctures, head and mesosoma with mostly black, grey, or pale hairs, male T7 usually with lateral lobe subtriangular, and large body size (9–17 mm in body length). A similarly scattered punctuation on the scutum and scutellum is also found in *A. vigintipunctatum*,



another Argentinean species; however, in that species the female clypeus is strongly convex in profile, the terga are dull or weakly shiny, the sternal scopa is whitish, the scutellum and scutum are maculate, and the lateral lobe of male T7 is subquadrate. In *A. sparsipunctatum* sp. nov., the female clypeus is weakly convex, the terga are glossy, distinctly smooth and shiny between punctures, the sternal scopa is black, and the scutellum and scutum are entirely black, without maculations.

*Description (paratypes in parentheses): Female.* Body length 11.8 mm (10.8–13.4); forewing length 9.2 mm (8.3–9.8). *Structure.* Clypeus weakly convex, projected about 0.4× width of compound eye in profile, distal margin thick, medially broad, sublaterally projected (Fig. 6B); mandible with eight teeth; labrum with small basal protuberances, separated by about a protuberance width, preapical projections reduced, indicated by strongly elevated border on lateral margin of furrow; F1 slightly more than twice as long as broad, shorter (–0.8×) than combined lengths of F2 and F3. Tibial carina absent. T6 gently convex basally, with small, acute lateral spine, preapical carina minutely crenulate, depressed apical rim on about one-half of gently convex distal margin. *Coloration.* Black, except ferruginous on antenna (distal flagellomeres darkened), pronotal lobe, tegula, distal two-thirds of femora, and remaining segments of legs (outer surface of mandible ferruginous basally); cream or yellow as follows: broad band on vertex and T1–T5 with medially interrupted bands, closer on apical terga. Wings light orange basally, brownish distally; veins ferruginous basally (including stigma and prestigma), dark brown distally. *Pubescence.* Dark brown to black, except as follows: whitish hairs on scape, superior paraocular area, frons, gena, sides of mesepisternum, metepisternum, and propodeum (sides of T1 in few paratypes); yellowish to light-brown hairs on vertex, scutum, axilla, and scutellum; ferruginous hairs on pronotal lobe, tegula, and ferruginous areas of legs. Fore basitarsus with sparse fringe of long hairs ( $\geq 2\times$  basitarsal width) along posterior margin. *Sculpturing.* Scutum and scutellum distinctly smooth and shiny between scattered, not contiguous punctures; propodeal triangle shagreened, finely lineolate to imbricate. T1–T5 with weakly elevated discal areas, glossy, smooth, shiny between sparse punctures (2–4× PW); depressed marginal zones more densely punctate than on discs (1–3× PW); distal margins smooth, shiny, about one-quarter width of depressed marginal zone.

*Male.* Body length 12.6–17.0 mm; forewing length 8.9–10.5 mm. *Structure.* Labrum without basal and preapical projections; F1 1.8× longer than broad, shorter (0.7×) than combined lengths of F2 and F3.

Lateral spine of T6 gently curved to nearly straight, about as long as median spine of T7; lateral lobe of T7 subtriangular, sometimes strongly angled on inner margin, thus appearing obliquely truncate; S4 with dense, dark-brown hair brush on median one-eighth of straight distal margin; S6, in ventral view, with gently convex basal margin, laterally with small, sharp, ventrally directed angle, distal margin sinuous; S7 hemisternite as in Figure 475; S8 with short, curved, simple apical process, basally broad, about one-third width of distal margin. Genitalia: gonostylus 3.0× longer than broad; volsella small, about one-third of gonostylar length, elongate, somewhat digitiform, ventrally curved in profile; penis valve about as long as gonostylus, long, apically narrow, pointed, blade-like, dorsoapical patch of hairs absent, medial projection large, distinct. *Coloration.* As in female, except yellow on outer surface of mandible, clypeus, and inferior paraocular area. *Pubescence.* As in female, except whitish or yellowish hairs on face, fore coxa, and femur.

*Holotype:* ♀, ARGENTINA: Catamarca Prov. 47 km S Belén, 1160 m a.s.l.; pantrap, 27°57.73'S, 67°12.34'W, 14 Sep 1999, M.E. Irwin, F.D. Parker (MLP).

*Paratypes:* 48 females, 37 males. ARGENTINA: Catamarca, 1♂, Andalgalá, 13 Oct 1973, J.L. Neff; 1♂, Belén, 45 km S, 14 Sep 1999, F.D. Parker, M.E. Irwin; 2♀, Belén, 47 km S, 12–14 Sep 1999, F.D. Parker, M.E. Irwin; 7♂, 10♀, Belén, 47 km S, 14 Sep 1999, M.E. Irwin, F.D. Parker; Chubut, 1♂, Dique Ameghino, J. Foerster; 1♀, Pto. Pirámides, Fritz; 2♂, Sarmiento, 24 km W, 21–31 Dec 2006, M.E. Irwin; La Pampa, 1♀, Lihue Calel, 21 Dec 1991; La Rioja, 2♂, Dept. Gen. Lavalle, Piedra Pintada, 12 Oct 1997, M. Irwin, F.D. Parker, S. Roig; 1♂, Mascasin, Fritz; Mendoza, 1♀, Altos Limpios, 21 Dec 1993, A. Roig; 4♀, Altos Limpios, 29 Apr 1993, A. Roig; 1♀, E Punta de Agua, 10 Nov 1987, L. Pena; Neuquén, 2♂, 1♀, Arroyito, 30 Nov 1989, Fritz; 1♂, Arroyito, 30 Nov 1989, U. Fritz; Río Negro, 4♀, Choele Choel, 15 Dec 1989; 4♀, Choele Choel, 25 Nov 1989; 2♀, Choele Choel, 5 Dec 1989; 7♀, Choele Choel, M. Fritz, U. Fritz; 8♂, Choele Choel, Dec 2011, M. Fritz, U. Fritz; 1♂, Choele Choel, Jan 1991, U. Fritz; 1♂, Choele Choel, Nov 1991, U. Fritz; 2♂, Choele Choel, 15 Dec 1989, U. Fritz; 2♂, 1♀, Choele Choel, 25 Nov 1989, U. Fritz; 1♂, Choele Choel, 5 Dec 1989, U. Fritz; 1♀, Darwin, Dec 1984, Fritz; 1♂, Lamarque, Nov 1984, Fritz; 1♀, Lamarque, Jan 1985, Fritz; 3♂, 5♀, Luis Beltrán, Nov 1987, Fritz; 1♀, Luis Beltrán, 25 Nov 1991, Fritz; San Juan, 1♀, San Juan, 52 km N, 31 Oct 1991, J.G. Rozen, L. Pena (AMNH, BBSL, CTMI, FSCA, MACN).

*Distribution:* ARGENTINA: Catamarca, Chubut, La Pampa, La Rioja, Mendoza, Neuquén, Río Negro, San Juan (0–1900 m a.s.l.). Recorded from Patagonian steppe, and High and Low Monte ecoregions (Fig. 583).

*Phenology:* September–January; late April.

*Etymology:* The epithet is a combination of the Latin words 'sparsum' (meaning scattered) and 'punctatum' (meaning punctures or holes), in reference to the scattered punctures of the scutum and scutellum that characterize this species.

#### **ANTHIDIUM SPATULATUM SP. NOV.**

FEMALE, FIGS 123, 200; MALE, FIGS 276, 403, 480, 557, 575

*Diagnosis:* Both sexes of this species are similar to *A. peruvianum* and *A. toro*, sharing the following combination of characters: legs dark; tibial carina absent; female labrum with distinct basal projections; fore basitarsus with outer surface not densely covered by tomentum; sternal scopa pale, at least laterally; male T6–T7 with lateral regions largely impunctate; male S4 without apical brush; and male S6 with median emargination on apical margin. Within this species group the female of *A. spatulatum* can be easily distinguished by T6 straight in profile, with the distal margin gently convex between the lateral and submedian spines, this distance approximately as long as the distance between the submedian spines (Fig. 200). The male is easily recognized by S6 with lateral lobe spatulate and a small median emargination, slightly broader than deep, on the distal margin (Fig. 403).

*Description: Female.* Body length 8.9–10.8 mm; forewing length 6.5–7.1 mm. *Structure.* Clypeus prominently convex, projected about 0.4× width of compound eye, distal margin thin, wavy to gently tuberculate (Fig. 123); mandible with five teeth; labrum with strong basal protuberances, visible even when mandibles closed, separated by about two times width of protuberance, preapical projections absent; F1 elongate, about 2.5× longer than broad, slightly longer than combined lengths of F2 and F3. Tibial carina absent. T6 straight in profile, distal margin crenulate, gently convex between lateral and submedian spines, this distance about as long as distance between submedian spines (Fig. 200). *Coloration.* Black, except: brownish on distal segments of antenna and distitarsi; yellow or cream as follows: outer surface of mandible (usually reduced or absent), distal half of clypeus, except medially (reduced in some paratypes), oval to rounded spot laterally on

vertex, T1–T3 with complete bands laterally, gently notched on posterior margins (sometimes briefly interrupted on T3), and remaining terga with medially interrupted bands. Wings hyaline, slightly brownish; veins and stigma dark brown. *Pubescence.* Whitish, except light ferruginous hairs on inner surfaces of tarsi; brownish hairs on vertex, dorsum of mesosoma (intermingled with whitish hairs), depressed marginal zones of T1–T5, T6 entirely, and apex of S6. Fore basitarsus with sparse fringe of long hairs ( $\geq 2\times$  basitarsal width) along posterior margin. *Sculpturing.* Propodeal triangle shiny, finely lineolate, nearly smooth. T1–T5 with weakly elevated discal areas, smooth, shiny between dense punctures (1–3× PW); depressed marginal zones slightly more densely punctate than on discs (1–2× PW); distal margins shiny, about one-quarter width of depressed marginal zone; T6 sparsely striate-punctate.

*Male (paratypes in parentheses).* Body length 9.5 mm (8.5–10.8); forewing length 7.1 mm (6.5–7.7). *Structure.* F1 about as long as broad, slightly shorter (0.8×) than combined lengths of F2 and F3. Lateral spine of T6 gently curved, stout, longer than median spine of T7; lateral lobe of T7 about 1.5× broader than distance between inner margin and median spine, narrow, apically curved, outer margin straight or nearly straight, inner margin crenulate, basally oblique (Fig. 276); S4 without apical brush, distal margin straight; S6, in ventral view, with strongly convex basal margin, laterally with long, ventromedially directed, spatulate lobe, distally with small median emargination (about 1.5× broader than deep) on one-fifth of straight distal margin (Fig. 403); S7 hemisternite as in Figure 480; S8 with median half of distal margin slightly projecting, pointed, not forming distinct apical process (Fig. 557). Genitalia: gonostylus robust, about 3.0× longer than broad; volsella reduced, barely indicated by elevated ridge (in ventral view); penis valve slightly shorter than gonostylus, rather narrow, apically truncate (not blade-like), dorsoapical patch of hairs absent, medial projection large, distinct (Fig. 575). *Coloration.* As in female, except yellow or cream on outer surface of mandible, clypeus, except distal margin, inferior paraocular area, and T3, with medially interrupted band (complete in two paratypes). *Sculpturing.* Terga slightly shinier, with broader distal margins than in female, about one-third width of depressed marginal zone.

*Holotype:* ♂, CHILE: Tarapaca, Putre, 30 Sep 1970 // Col. H. Toro // AMNH\_BEE 00015929 (AMNH).

*Paratypes:* 17 females, 22 males. CHILE: Arica, Parinacota, Parinacota Prov., 1♂, Belén, N, 12 Nov 1983, L. Peña; 1♂, 2♀, Putre, 30 Sep 1970, de la Hoz; 4♂, 2♀, Putre, 30 Sep 1970, H. Toro; 1♂, 2♀, Putre, 16

Nov 1997, L. Packer; 1♀, Zapahuira, 17 Sep 1984, H. Toro; 2♂, 1♀, Zapahuira, 10 km S of Putre, 9 Nov 1999, G.A.R. Melo; Atacama, Chañaral Prov., 1♀, Chañaral, 11 Oct 1981, C. Tobar; Tarapacá, Iquique Prov., 2♂, 1♀, Chusmiza, 3583 m a.s.l., 15 Oct 1981, H. Burgos; 1♀, Chusmiza, 3583 m a.s.l., 15 Oct 1981, J. Magunacelaya; Tamarugal Prov., 1♂, Chusmisa, 15 Oct 1981, B. Dyer; 1♀, Chusmisa, 15 Oct 1981, H. Burgos; 1♀, Chusmisa, 15 Oct 1981, J. Magunacelaya; 1♂, Chusmisa, 15 Oct 1981; 1♀, Chusmisa, 15 Oct 1981, B. Dyer; 1♂, Chusmisa, 15 Oct 1981, H. Burgos. (AMNH, BBSL, DZUP, PCYU).

*Distribution*: CHILE: Arica and Parinacota, Atacama, Tarapacá (3300–4400 m a.s.l.). Found in the Central Andean dry puna ecoregion.

*Phenology*: September–November.

*Etymology*: The specific epithet makes reference to the distinctive spatulate lateral lobe of S6 of the male.

#### *ANTHIDIUM TARSOI* URBAN, 2001

FEMALE, FIGS 124, 201

*Anthidium tarsoi* Urban, 2001b: 548 (holotype: DZUP; ♀, Canta, Lima, Peru).

*Diagnosis*: This species is known only from the female holotype (but see comments below). It shares with *A. chilense* the following combination of characters: basitarsi with outer surfaces densely covered by tomentum; hind tibia without carina; clypeus with distal margin thin; and T6 with small but distinct medial notch on distal margin. It can be readily distinguished from *A. chilense* by the face all black, terga with distal margins broad (about one-third width of depressed marginal zone), and the form of the depressed apical rim on the median one-third of the distal margin of T6 (Fig. 201).

*Description: Female*. Body length 9.0 mm. *Structure*. Clypeus weakly convex, distal margin thin, straight, slightly projected sublaterally (Fig. 124); mandible with five or six teeth; F1 2.1× longer than broad, slightly shorter (~0.9×) than combined lengths of F2 and F3. Tibial carina weakly indicated, nearly absent. T6 flat in profile, without distinct lateral angle, preapical carina minutely crenulate, depressed apical rim on median one-third of distal margin (Fig. 201). *Coloration*. Black, except: ferruginous on legs excluding coxae, trochanters of fore and middle legs, and most of fore femur; yellow as follows: small, rounded spot laterally on vertex, terga with medially interrupted bands, laterally notched on anterior margin. Wings light orange basally, brownish distally; veins

ferruginous basally, dark brown distally, including stigma. *Pubescence*. Whitish, except: light ferruginous hairs on inner surfaces of tarsi; dark brown to black hairs on centre of sternal scopa, and discs of T2–T6. Outer surfaces of basitarsi densely covered by tomentum (integument not visible among hairs). *Sculpturing*. Propodeal triangle weakly shiny, weakly lineolate to imbricate. T1–T5 with weakly elevated discal areas, weakly shiny, weakly lineolate to imbricate between punctures (2–3× PW); depressed marginal zones with denser punctures than on discs (1–2× PW); distal margins dull, broad, about one-third width of depressed marginal zone.

*Distribution*: PERU: Lima (2800 m a.s.l.). Recorded from the Sechura desert ecoregion.

*Phenology*: May.

*Comments*: Urban (2001b) described a female specimen from Huaylas (Departamento of Ancash) as the female of *A. igori* (see species account); however, that female seems to be conspecific with *A. tarsoi*. We did not find significant morphological differences between the females of the two species, except for the slightly duller T1–T5, each with four yellow spots, instead of the medially interrupted bands in *A. tarsoi*.

#### *ANTHIDIUM TENUIFLORAE* COCKERELL, 1907

FEMALE, FIGS 125, 202; MALE, FIGS 277, 329, 404, 481, 558; MAP, FIG. 582

*Anthidium tenuiflorae* Cockerell, 1907a: 135 (holotype: UCR; ♀, Boulder, Colorado, USA).

*Anthidium tenuiflorae yukonense* Cockerell, 1926b: 622 (holotype: AMNH; ♂, Carcam, Yukon Terr., Canada); Grigarick & Stange, 1968: 32 (synonymy with *tenuiflorae*).

*Diagnosis*: The female of this species is easily recognized by the following combination of characters: clypeus weakly convex (Fig. 125); sternal scopa pale, at least laterally; fore and mid basitarsi with pubescence pale in part; terga smooth and shiny, with depressed marginal zones coarsely and densely punctate; and T6 densely punctate on disc, distally truncate, with median emargination very weak or absent (Fig. 202). The male resembles that of *A. emarginatum* and *A. platyfrons* sp. nov. in the T7 with lateral lobe broad (Fig. 277), and S4 with apical brush consisting of long, black hairs (Fig. 329); it can be separated from those species by the narrower lateral lobe of S6 with outer margin usually concave (lobe appearing digitiform) (Fig. 404), and S8 with apical process longer and narrower (Fig. 558).



*Description: Female.* Body length 8.0–9.3 mm; forewing length 6.2–7.4 mm. *Structure.* Clypeus weakly convex, projected about 0.4× width of compound eye in profile, distal margin thin, wavy, two lateralmost tubercles usually more distinctly projected (Fig. 125); mandible with six teeth; labrum without basal protuberances, preapical projections large, distinctly curved upwards; F1 1.7× longer than broad, shorter (~0.7×) than combined lengths of F2 and F3. Tibial carina absent. T6 gently convex in profile, without distinct lateral angle, preapical carina absent, depressed apical rim projecting on entire truncate distal margin, median emargination weakly sinuate or absent (Fig. 202). *Coloration.* Dark brown to black, except light brown on tarsi; ivory or yellow maculations as follows: rounded to oval spot laterally on vertex, anterior half of tegula, outer surface of tibiae basally, and medially interrupted bands on terga (especially on T1 and T6), laterally deeply notched on anterior margin (sometimes broken into four spots on T1 and reduced on T6). Wings hyaline, slightly brownish; veins and stigma dark brown. *Pubescence.* Whitish or yellowish, except darker hairs on inner surfaces of tarsi, and centre of sternal scopa. Fore and mid basitarsi with outer surfaces densely covered by tomentum (integument not visible among hairs). *Sculpturing.* Propodeal triangle weakly shiny, finely lineolate. T1–T5 with weakly elevated discal areas, weakly imbricate–lineolate, nearly smooth, shiny between punctures (1–2× PW); depressed marginal zones with smaller, coarser, denser ( $\leq 1\times$  PW) punctures than those on discs; distal margins with distinct, narrow (1–3× PW), smooth shiny border.

*Male.* Body length 8.9–13.1 mm; forewing length 6.9–8.5 mm. *Structure.* F1 1.3× longer than broad, shorter (0.6×) than combined lengths of F2 and F3; labrum with preapical projections longer than in female. Lateral spine of T6 straight, about as long as median spine of T7; lateral lobe of T7 broad, apically rounded, basally about 1.5× broader than distance between inner margin and median spine (Fig. 277); S4 with apical brush of long, black hairs on median one-third of gently concave distal margin (Fig. 329); S6, in ventral view, with gently convex basal margin, outer margin of acute lateral lobe usually concave (lobe thus appearing nearly digitiform), median lobe broadly rounded, with entire distal margin (Fig. 404); S7 hemisternite apically pointed (Fig. 481); S8 with broad apical process, about one-quarter width of distal margin basally, deeply bifid apically, with pointed lobes ventrally bent in nearly right angle (Fig. 558). Genitalia: gonostylus robust, 3.3× longer than broad; volsella small, less than one-third of gonostylar length, apically truncate in profile, appearing triangular in ventral view; penis valve about half of gonostylar length, apex broad, flattened, dorsoapi-

cal patch of hairs present, medial projection small. *Coloration.* As in female, except ivory or yellow maculations as follows: outer surface of mandible, clypeus, inferior paraocular area, anterior surfaces of scape, and F1 (usually reduced or absent), anterolateral and lateral margins of scutum (sometimes with small spots), distal margin of scutellum (usually absent), outer surfaces of fore and middle tibiae distally (sometimes absent), outer surfaces of basitarsi, and T6 with two submedian spots. *Pubescence.* Sterna usually with whitish hairs. *Sculpturing.* Terga slightly smoother, shinier than in female.

*Distribution:* MEXICO: Baja California. USA: from California, Arizona, northern New Mexico, Colorado to Washington, Montana, North Dakota, Minnesota, Alaska. CANADA: British Columbia, Yukon, Alberta, Saskatchewan (0–3900 m a.s.l.). This is perhaps the most widespread *Anthidium* in North America. It occupies a wide array of ecoregions from Sierra Juarez and San Pedro Martir pine–oak forests and California montane chaparral and woodlands through forests and shrub steppe to grasslands and tundra; absent from deserts (Fig. 582).

*Phenology:* Late March–September; single record from late November; June through August accounts for 98% of records.

*Floral records:* ALLIACEAE: *Allium cernuum*. ASTERACEAE: *Aster foliaceus* var. *apricus*, *Aster occidentalis*, *Aster occidentalis* var. *yosemitanus*; *Balsamorhiza* sp.; *Chrysothamnus depressus*; *Cirsium* sp.; *Erigeron pumilus*; *Gaillardia pinnatifida*; *Senecio* sp.; *Solidago confinis*. BORAGINACEAE: *Phacelia argillacea*, *Phacelia frigida*, *Phacelia hastata*, *Phacelia heterophylla*, *Phacelia leptosepala*, *Phacelia leucophylla*. BRASSICACEAE: *Streptanthus tortuosus*. CARYOPHYLLACEAE: *Arenaria kingii*. CRASSULACEAE: *Sedum lanceolatum*, *Sedum obtusatum*. FABACEAE: *Astragalus calycosus*, *Astragalus kentrophyta*, *Astragalus miser*, *Astragalus montii*, *Astragalus tenellus*; *Lotus argophyllus*, *Lotus davidsonii*, *Lotus nevadensis*; *Lupinus breweri*, *Lupinus confertus*, *Lupinus duranii*, *Lupinus lepidus* var. *lobbii*; *Medicago sativa*; *Melilotus officinalis*; *Trifolium oliganthum*; *Vicia villosa*. LAMIACEAE: *Monardella odoratissima*; *Poliomintha incana*; *Salvia dorrii*. ONAGRACEAE: *Epilobium andenocaulon* var. *parishii*; *Epilobium ciliatum*. PLANTAGINACEAE: *Penstemon secundiflorus*, *Penstemon unilateralis*. ROSACEAE: *Horkelia fusca*; *Ivesia santolinoides*; *Potentilla glandulosa*, *Potentilla gracilis*; *Rubus idaeus*.

*Biology:* Presumably nests in holes in the ground and uses pebbles to build the nest plug, as indicated by Hicks (1926).

*Comments:* Some specimens from Baja California, Mexico, are brighter yellow than specimens from other localities, with the following areas maculated: nearly entire clypeus, lower paraocular area, outer surface of mandible, pronotal lobe, axilla, and distal margin of scutellum (except medially). T6 of the female is also slightly more convex and distally truncate, with the depressed apical rim broader near the lateral angle, and the median emargination is small but still present. However, all these characters vary among specimens of other localities, and no significant differences are found in the male genitalia and associated sterna that would warrant its recognition as a distinct species. The lateral lobe of S6 of the male is usually digitiform (its outer margin being more concave than the inner margin), but in specimens from the same locality sometimes it is nearly triangular, as in *A. emarginatum*; in those cases, it can be distinguished by the whitish colour of the sternal hairs and the shape of the median lobe.

*ANTHIDIUM TORO* URBAN, 2001

FEMALE, FIGS 126, 203; MALE, FIGS 278, 405, 482, 559

*Anthidium toro* Urban, 2001b: 549 (holotype: DZUP; ♂, Loyoques, El Loa, Chile).

*Diagnosis:* Both sexes of this species are similar to those of *A. peruvianum* and *A. spatulatum* sp. nov. (see above). The female of *A. toro* can be easily separated from those species by T6 with distal margin straight or nearly straight between the lateral and submedian spines, slightly longer than distance between submedian spines (Fig. 203). The male can be recognized by the S5 with distal margin gently concave on the median three-quarters, and S6 with lateral spine short and blunt, and a deep median emargination on the distal margin (Fig. 405). In addition, T1 and T2 of both sexes usually have medially interrupted bands (but see comments below).

*Description: Female.* Body length 9.5 mm; forewing length 6.6 mm. *Structure.* Clypeus prominently convex, projected about 0.4× width of compound eye, distal margin thin, wavy to gently tuberculate (Fig. 126); mandible with five teeth; labrum with strong basal protuberances, visible even when mandibles closed, separated by about two times width of protuberance, preapical projections absent; F1 elongate, about 3.0× longer than broad, about 1.2× longer than combined lengths of F2 and F3. Tibial carina

absent. T6 straight in profile, distal margin crenulate, straight or nearly straight between lateral and submedian spines, slightly longer than distance between submedian spines (Fig. 203). *Coloration.* Black, except brownish to light ferruginous on antenna and distitarsi (sometimes also outer surface of mandible and basitarsus); yellow or cream as follows: distal half of clypeus, except medially, oval to rounded spot laterally on vertex, and terga with medially interrupted bands, laterally slightly notched on posterior margin (except on T6). Wings hyaline, slightly brownish; veins and stigma dark brown. *Pubescence.* Whitish, except light ferruginous hairs on inner surfaces of tarsi; brownish hairs on vertex, scutellum (intermingled with whitish hairs), depressed marginal zones of T1–T5, and apex of S6. Fore basitarsus with sparse fringe of long hairs ( $\geq 2\times$  basitarsal width) along posterior margin. *Sculpturing.* Propodeal triangle shiny, finely lineolate, nearly smooth. T1–T5 with weakly elevated discal areas, smooth, shiny between dense punctures (1–3× PW); depressed marginal zones about as densely punctate as on discs; distal margins shiny, narrow (2–3× PW); T6 as densely punctate as on preceding terga, slightly denser along midline.

*Male.* Body length 10.8 mm; forewing length 7.1 mm. *Structure.* Labrum without basal protuberances; F1 2.4× longer than broad, slightly shorter (0.9×) than combined lengths of F2 and F3. Lateral spine of T6 gently curved, about as long as median spine of T7; lateral lobe of T7 narrower ( $\sim 0.7\times$ ) than distance between inner margin and median spine, apically narrow, curved, outer margin nearly straight, inner margin basally oblique (Fig. 278); S4 without apical brush, distal margin straight; S6, in ventral view, with gently convex to nearly straight basal margin, laterally with short, blunt spine, with broad median emargination ( $\sim 3.3\times$  broader than deep) on 0.4× distal margin (Fig. 405); S7 hemisternite as in Figure 482; S8 with rather long, ventrally bent ( $\sim 70^\circ$ ), simple apical process, basally broad, about one-half width of distal margin (Fig. 559). Genitalia: gonostylus robust, about 3.0× longer than broad; volsella reduced, not distinguishable in ventral view, barely indicated by elevated ridge; penis valve about as long as gonostylus, rather narrow, apically pointed (not blade-like), lateral margin projecting into small dorsal lobe at same level as medial projection, dorsoapical patch of hairs absent, medial projection large, distinct. *Coloration.* As in female, except yellow or cream on outer surface of mandible, clypeus, except distal margin, inferior paraocular area and T7 with two lateral spots (usually absent). *Sculpturing.* Terga slightly shinier than in female; T6 scarcely punctate laterally, with large, smooth impunctate areas.

*Distribution:* CHILE: Antofagasta. ARGENTINA: Jujuy and Salta. Recorded from the Central Andean puna and Central Andean dry puna ecoregions (3500–4400 m a.s.l.).

*Phenology:* Late September–early December.

*Comments:* Two female specimens from north-western Peru might belong to this species; however, the distal margins of T2–T5 are broader (about one third of the depressed marginal zone), and T6 is slightly more convex, and with the distance between the lateral and submedian spines greater (1.5×) than in specimens of *A. toro* from Argentina and Chile; also, the yellow bands are complete on all terga, slightly notched laterally on the posterior margin, and narrowed to distinctly notched medially on the apical terga. They may represent a new species, but we chose to defer description until more material and/or the male becomes available. The specimens are in the American Museum of Natural History, with the following label data: 'Peru: Ancash Dept. Conococha, 4000 m, VII-1-95, J.G. Rozen, A. Ugarte // *Anthidium* (A.) *peruvianum* Schrottky, 1910 det. J.S. Ascher // AMNH\_BEE 00015902 and 00015903'.

#### *ANTHIDIUM UTAHENSE* SWENK, 1914

FEMALE, FIGS 28, 127; MALE, FIGS 279, 330, 406, 483, 560; MAP, FIG. 582

*Anthidium utahense* Swenk, 1914: 23 (holotype: UNSM; ♂, Logan, Utah, USA).

*Anthidium sagittipictum* Swenk, 1914: 20 (holotype: UNSM; ♀, Pullman, Washington, USA); Grigarick & Stange, 1968: 33 (synonymy with *utahense*).

*Anthidium divisum* Cockerell, 1925a: 350 (holotype: CAS 1733; ♀, Parley Canyon, Salt Lake City, Utah, USA); Grigarick & Stange, 1968: 33 (synonymy with *utahense*).

*Anthidium divisum ornatifrons* Cockerell, 1925a: 350 (holotype: CAS 1734; ♀, Meadow Valley, Plumas Co., California, USA); Grigarick & Stange, 1968: 33 (synonymy with *utahense*).

*Anthidium divisum nanulum* Cockerell, 1925a: 350 (holotype: CAS 1735; ♀, Bryson, Monterey, California, USA); Grigarick & Stange, 1968: 33 (synonymy with *utahense*).

*Anthidium brachyurum* Cockerell, 1925a: 357 (holotype: CAS 1738; ♂, Cisco, California, USA); Grigarick & Stange, 1968: 33 (synonymy with *utahense*).

*Diagnosis:* This species is most similar to *A. jocosum* (see above). The female can be separated from that species by the T6 with distal margin more truncate

and conspicuously depressed apical rim (Fig. 28), and the clypeus and inferior paraocular area usually yellow (Fig. 127). The male is distinguished by the S4 with more developed apical brush (Fig. 330) and S6 with lateral lobe acute, usually darker and more strongly sclerotized than the median lobe (Fig. 406).

*Description: Female.* Body length 6.2–10.3 mm; forewing length 4.6–6.2 mm. *Structure.* Clypeus prominently convex, projected about 0.4× width of compound eye in profile, distal margin thin, straight or nearly straight, two lateralmost tubercles distinctly projected (Fig. 127); mandible with five teeth; labrum without basal protuberances, preapical projections large, distinctly curved upwards; F1 1.7× longer than broad, slightly shorter (~0.8×) than combined lengths of F2 and F3. Tibial carina absent. T6 gently swollen in profile, with small but distinct lateral angle, preapical carina absent, depressed apical rim distinct, projecting on entire, somewhat truncate, distal margin (Fig. 28). *Coloration.* Dark brown to black, except: light brown on tarsi; yellow as follows: outer surface of mandible, clypeus, except for mid-apical small dark spot and W-shaped dark spot on basal third, inferior paraocular area, rounded to oval spot laterally on vertex, pronotal lobe, tegula, except on disc (sometimes reduced), anterolateral and lateral margins of scutum with thin band (usually reduced or absent), axilla (usually reduced or absent), distal margin of scutellum, except medially (sometimes reduced), inferior margin of femora distally, T1 usually with four spots, and remaining terga with medially interrupted bands, laterally deeply notched on anterior margin (except on T6), usually closer on T4 and T5. Wings hyaline, slightly brownish; veins and stigma mostly dark brown. *Pubescence.* Whitish, except light ferruginous to yellowish hairs on vertex, scutum, axilla, scutellum, inner surfaces of tarsi, and sometimes on S6. Clypeus with sparse, apically curved hairs. Outer surfaces of fore and middle basitarsi sparsely covered by tomentum (integument barely visible among hairs). *Sculpturing.* Propodeal triangle weakly lineolate, nearly smooth, shiny. T1–T5 with weakly elevated discal areas, smooth, shiny, between coarse, dense punctures (1–2× PW); depressed marginal zones with punctures as large as those on discs, nearly contiguous; distal margins smooth, shiny, narrow (1–2× PW), slightly thickened, doubly carinate.

*Male.* Body length 8.5–10.8 mm; forewing length 5.8–7.1 mm. *Structure.* F1 1.3× longer than broad, shorter (0.6×) than combined lengths of F2 and F3; labrum with preapical projections longer than in female. Lateral spine of T6 straight or nearly straight, about as long as median spine of T7; lateral



lobe of T7 subquadrate, basally slightly more than two times broader than distance between inner margin and median spine (Fig. 279); S4 with apical brush of dense, short, light-reddish brown hairs on median one-sixth of straight distal margin (Fig. 330); S6, in ventral view, with gently convex basal margin, lateral lobe more acute than in *A. jocosum*, usually darker, more strongly sclerotized than broadly rounded median lobe (Fig. 406); S7 hemisternite as in Figure 483; S8 with long, narrow apical process, deeply bifid apically, with pointed lobes ventrally bent ( $\sim 100^\circ$ ), heron or egret's head shaped in profile view (Fig. 560). Genitalia: gonostylus robust,  $3.3\times$  longer than broad, nearly straight, with somewhat pointed apex in profile view; volsella small, about one-third of gonostylar length, obliquely truncate, appearing triangular in ventral view; penis valve about half of gonostylar length, apically broad, dorsoapical patch of hairs present, medial projection small. *Coloration*. As in female, except yellow on clypeus and basitarsi; maculations on pronotal lobe, scutum, axilla, scutellum, and outer surfaces of tibiae, usually reduced or absent.

*Distribution*: USA: widespread and common west of Rocky Mountains. CANADA: southern British Columbia. MEXICO: Baja California (0–2700 m a.s.l.). Apparently absent from Arizona and New Mexico. Occupies a wide array of ecoregions, including Sierra Juarez and San Pedro Martir pine–oak forests, Mojave and Sonoran deserts, California chaparral and woodlands, montane and coastal forests, shrub steppe, and grasslands (Map 582). Despite its name it is absent from much of Utah, including the Colorado Plateau, and appears to be most numerous in mediterranean California (60% of records).

*Phenology*: Late March–mid September; one record from 23 October; the period from May through July accounts for 90% of records.

*Floral records*: ALLIACEAE: *Allium lacunosum*. ASTERACEAE: *Artemisia* sp.; *Aster* sp.; *Calycadenia multiglandulosa*; *Centaurea solstitialis*; *Chaenactis glabriuscula*, *Chrysothamnus* sp.; *Cirsium arvense*, *Cirsium vulgare*; *Erigeron* sp.; *Grindelia* sp.; *Gutierrezia sarothrae*; *Hemizonia lobbii*; *Hypochaeris radicata*; *Leucanthemum vulgare*; *Solidago californica*. BORAGINACEAE: *Amsinckia menziesii* var. *menziesii*; *Cryptantha intermedia*, *Cryptantha muricata*; *Eriodictyon californicum*, *E. tomentosum*; *Phacelia brachyloba*, *Phacelia californica*, *Phacelia cicutaria*, *Phacelia distans*, *Phacelia imbricata*, *Phacelia linearis*, *Phacelia malvifolia*, *Phacelia ramosissima*; *Pholistoma auritum*; *Plagiobothrys* sp. BRASSICACEAE: *Brassica nigra*; *Sisymbrium altissimum*. CACTACEAE:

*Echinocactus* sp. CLEOMACEAE: *Cleome* sp. CRASSULACEAE: *Sedum* sp. EUPHORBIACEAE: *Croton californicus*. FABACEAE: *Astragalus bolanderi*; *Cassia fasciculata*; *Lotus argophyllus* var. *fremontii*, *Lotus douglasi*, *Lotus corniculatus*, *Lotus hamatus*, *Lotus humistratus*, *Lotus nevadensis*, *Lotus nevadensis* var. *nevadensis*, *Lotus nuttallianus*, *Lotus purshianus*, *Lotus scoparius*, *Lotus strigosus*, *Lotus wrangelianus*; *Lupinus bicolor*, *Lupinus nanus*; *Medicago sativa*; *Melilotus alba*. FAGACEAE: *Quercus* sp. LAMIACEAE: *Marrubium vulgare*; *Salvia mellifera*. LILIACEAE: *Calochortus venustus*. MALVACEAE: *Sidalcea neomexicana*. ONAGRACEAE: *Clarkia amoena*, *Clarkia cylindrica*, *Clarkia purpurea*, *Clarkia speciosa*, *Clarkia unguiculata*; *Oenothera* sp. PLANTAGINACEAE: *Antirrhinum coulterianum*; *Collinsia heterophylla*; *Penstemon* sp. POLEMONIACEAE: *Eriastrum pluriflorum*. POLYGONACEAE: *Chorizanthe douglasii*; *Eriogonum fasciculatum*; *Polygonum* sp.; *Rumex acetosella*. PORTULACACEAE: *Calyptridium umbellatum*. RHAMNACEAE: *Ceanothus* sp. ROSACEAE: *Adenostoma fasciculatum*; *Chamaebatia foliosa*; *Horkelia bolanderi* spp. *clevelandii*, *H. glandulosa*; *Rubus ursinus*. THEMIDACEAE: *Bloomeria crocea*; *Triteleia laxa*.

*Biology*: Nests consist of between one and four cells, and are built in the ground in holes or crevices. Cells are made with plant trichomes from *Cirsium* and *Artemisia*, and the nest is plugged with pebbles. Cuckoo bees of the genus *Dioxys* Lepeletier & Serville, 1825 have been recorded from brood cells (Jaycox, 1966).

ANTHIDIUM VIGINTIDUOPUNCTATUM FRIESE, 1904

FEMALE, FIGS 128, 204; MALE, FIGS 280, 331, 407, 484, 561

*Anthidium* 22-punctatum [sic] Friese, 1904a: 182 (lectotype: ZMB; ♂, Guayaquil, Guayas, Ecuador) (new lectotype designation).

*Diagnosis*: The female of this species superficially resembles that of *A. cuzcoense* in body colour (dark brown to black, with T1–T4 each with four yellow spots), fore and mid basitarsi with outer surfaces densely covered by tomentum; hind tibia with carina; and terga weakly shiny. It can be easily distinguished by the terga duller, with depressed marginal zones more densely punctate ( $\leq 1\times$  PW) and distal margins narrower ( $1\text{--}2\times$  PW), and the T6 without lateral spine and distal margin nearly straight (Fig. 204). The male can be recognized by the T7 with lateral lobe spiniform, shorter and broader than the digitiform submedian spine (Fig. 280), and S6 with distal margin medially sinuous (Fig. 407).

*Description: Female.* Body length 9.2 mm; forewing length 6.8 mm. *Structure.* Clypeus weakly convex, projected about 0.3× width of compound eye in profile, distal margin thin, straight, two lateralmost tubercles usually distinctly projected (Fig. 128); labrum with strong basal protuberances separated by about width of protuberance, preapical projections large, distinctly curved upwards; mandible with eight or nine teeth; F1 1.7× longer than broad, shorter (0.8×) than combined lengths of F2 and F3. Tibial carina present. T6 straight in profile, without distinct lateral spine, preapical carina minutely crenulate, depressed apical rim projecting on about median one-third of nearly straight distal margin (Fig. 204). *Coloration.* Dark brown to black, except: light ferruginous on distitarsi; yellow as follows: outer surface of mandible, distal two-thirds of clypeus, except medially and distal margin, inferior paraocular area, short band laterally on vertex, anterior and posterior ends of tegula, anterolateral and lateral margins of scutum with continuous band (sometimes reduced), axilla, distal margin of scutellum, except medially, inferior margins of femora apically (usually reduced on fore and hind femora), superior margins of femora apically, outer surfaces of fore and middle tibiae, posterior margin of hind tibia with broad band ending before apex, T1–T4 each with four large spots, and T5 and T6 with two large submedian spots. Wings hyaline, slightly brownish; veins and stigma dark brown. *Pubescence.* Whitish, except light-brown to ferruginous hairs on vertex, dorsum of mesosoma, inner surfaces of tarsi, and terga (sometimes entirely whitish). Outer surfaces of basitarsi densely covered by tomentum (integument not visible among hairs). *Sculpturing.* Propodeal triangle dull, finely imbricate. T1–T5 with weakly elevated discal areas, dull or weakly shiny, weakly lineolate or imbricate between punctures (2–3× PW); depressed marginal zones more densely punctate than on discs ( $\leq 1\times$  PW); distal margins narrow (1–2× PW), little differentiated from rest of depressed marginal zone.

*Male.* Body length 10.8–13.1 mm; forewing length 8.2–8.9 mm. *Structure.* Labrum without basal and preapical protuberances or projections; F1 1.6× longer than broad, shorter (0.7×) than combined lengths of F2 and F3. Lateral spine of T6 gently curved, longer than median spine of T7; lateral lobe of T7 spiniform, shorter, broader than digitiform submedian spine (Fig. 280); S4 with sparse, light-reddish brown hair brush on median one-quarter of nearly straight distal margin, often hardly seen among sternal hairs (Fig. 331); S6, in ventral view, with basal margin straight or nearly straight, laterally with small, sharp, ventrally directed spine, distal margin medially sinuous (Fig. 407); S7 hemisternite as in Figure 484; S8 with median third of distal margin projecting into triangular lobe, apically curved

(Fig. 561). Genitalia: gonostylus robust, distinctly clubbed, about twice as long as broad; volsella reduced, not distinguishable in ventral view, barely indicated by elevated ridge; penis valve slightly shorter than gonostylus, basally narrow, apex long, blade-like, pointed, strongly curved, dorsoapical patch of hairs reduced or absent, medial projection absent. *Coloration.* As in female, except yellow on clypeus, basitarsi, T5 with four spots, and T6 with two large submedian spots; maculations more extensive on femora. *Sculpturing.* Terga slightly shinier, with broader distal margins than in female.

*Distribution:* PERU: Ancash, La Libertad, Lambayeque, Lima, Piura, San Martín. ECUADOR: Galápagos, Guayas, Imbabura, Manabí (0–3100 m a.s.l.). Recorded from Sechura Desert, Tumbes–Piura dry forest, north-western Andean montane forests, western Ecuador moist forest, High Monte, Peruvian Yungas, and Galápagos Islands scrubland mosaic ecoregions. Recently documented from the island of Floreana in the Galápagos Islands (Gonzalez *et al.*, 2010). Boada (2005), and Causton *et al.* (2006) have also recorded an unidentified species of *Anthidium* from the islands of Santa Cruz and San Cristóbal, collected in 2001 and 2002, respectively. We were unable to study this material to determine its identity.

*Phenology:* January, March, May–August, October, December.

*Floral records:* PEDALIACEAE: *Sesamum indicum*.

*Comments:* Friese (1904a) described *A. vigintiduopunctatum* based on both males and females from Guayaquil, Ecuador. The label data for the male specimen, herein designated as the lectotype to stabilize the name, are as follows: ‘Ecuador, Guayaquil, 5, 1901 (May 1901), Buchwald // *Anthidium xx-punctatum* (illegible number, presumably 22), ♂ 1900 Friese det. // Zool. Mus. Berlin // Lectotype 22-punctatum ♂ Friese Des. V.H. Gonzalez & T. Griswold 2010’.

#### ANTHIDIUM VIGINTIPUNCTATUM FRIESE, 1908

FEMALE, FIGS 6C, 17, 205; MALE, FIGS 281, 332, 408, 485, 562; MAP, FIG. 583

*Anthidium viginti-punctatum* [sic] Friese, 1908: 71 (lectotype: ZMB; ♂, Mendoza, Argentina) (**new lectotype designation**).

*Diagnosis:* Both sexes of this species are easily recognized by the body colour (black with antenna, pronotal lobe, tegula, and legs ferruginous, and

T1–T4 each with four yellow spots) and the discs of scutum and scutellum distinctly smooth and shiny between sparse punctures (Fig. 17). Further characters that help identify this species are: female T6 with lateral spine small, acute, and a distinctly depressed apical rim projecting as a rectangle on approximately half the width of the distal margin (Fig. 205); male T7 with lateral lobe subquadrate (Fig. 281); and male S6 laterally with small, sharp, ventrally directed angle, and distal margin straight, with a small median projection (Fig. 408).

**Description: Female.** Body length 9.5–11.2 mm; forewing length 7.7–8.5 mm. **Structure.** Clypeus strongly convex, projected about 0.5× width of compound eye, distal margin thick, wavy, sublaterally projected (Fig. 6C); mandible with six teeth; labrum without basal protuberances, preapical protuberances low, indicated by elevated ridge on lateral margin of furrow; F1 1.8× longer than broad, slightly shorter (0.9×) than combined lengths of F2 and F3. Tibial carina absent. T6 nearly straight in profile, gently convex basally, with small, acute lateral spine, preapical carina crenulate, depressed apical rim distinct, projecting as a rectangle on about half width of nearly straight distal margin (Fig. 205). **Coloration.** Black, except: ferruginous on antenna, pronotal lobe, tegula, and legs, excluding coxae, trochanters, bases of femora, and sometimes outer surfaces of basitarsi; cream or yellow as follows: outer surface of mandible (usually darkened), distal two-thirds of clypeus, except medially and on distal margin, inferior paraocular area, complete band on vertex (sometimes medially interrupted), lateral margin of scutum (short band, about as long as tegula or shorter), axilla, distal margin of scutellum, except medially, T1–T4 each with four spots, and T5 with two submedian spots. Wings subhyaline, dark brown; veins and stigma dark brown. **Pubescence.** Whitish, except ferruginous hairs on inner surfaces of tarsi; brownish hairs on frons, vertex, axilla, discs of scutum, scutellum, and terga (except on T1 and T2, and sides of terga). Fore basitarsus with sparse fringe of long hairs ( $\geq 2\times$  basitarsal width) along posterior margin. **Sculpturing.** Scutum and scutellum distinctly smooth, shiny between larger, sparser punctures ( $1\text{--}2\times$  PW) than on vertex; propodeal triangle dull, strongly lineolate to imbricate. T1–T5 with weakly elevated discal areas, weakly shiny, finely lineolate between sparse punctures ( $2\text{--}4\times$  PW); depressed marginal zones more densely punctate than on discs ( $1\text{--}2\times$  PW); distal margins dull, narrow ( $\sim 3\text{--}4\times$  PW).

**Male.** Body length 9.2–14.6 mm; forewing length 7.2–9.5 mm. **Structure.** F1 1.6× longer than broad, shorter (0.7×) than combined lengths of F2 and F3. Lateral spine of T6 gently curved, about as long as

median spine of T7; lateral lobe of T7 subquadrate, about twice as broad as distance between inner margin and median spine (Fig. 281); S4 with apical brush of long, dark-reddish brown hairs on median one-eighth of straight distal margin (Fig. 332); S6, in ventral view, with gently convex to nearly straight basal margin, laterally with small, sharp, ventrally directed spine, distal margin straight, with small median projection (Fig. 408); S7 hemisternite as in Figure 485; S8 with short, curved, simple apical process, basally broad, about one-third width of distal margin (Fig. 562). **Genitalia:** about 3.0× longer than broad; volsella small, about one-third of gonostylar length, apically narrowed, digitiform, ventrally curved; penis valve about as long as gonostylus, apically long, narrow, pointed, blade-like, dorsoapical patch of hairs absent, medial projection large, distinct. **Coloration.** As in female, except yellow on outer surface of mandible, clypeus, anterior surface of scape, T5 with four spots, and T6 with two submedian spots; F3–F11 sometimes darkened; maculations on scutum, axilla, scutellum, and T1, usually reduced or absent. **Sculpturing.** Terga smoother, shinier, with broader distal margins than in female.

**Distribution:** ARGENTINA: Catamarca, Córdoba, La Rioja, Mendoza, Río Negro, Salta, (100–2100 m a.s.l.). Recorded from High and Low Monte and Dry Chaco ecoregions (Fig. 583).

**Phenology:** October–early December.

**Floral records:** FABACEAE: *Zuccagnia punctata*. RANUNCULACEAE: *Clematis* sp.

**Comments:** Friese (1908) described *A. vigintipunctatum* based on both males and females from Mendoza, Argentina. To stabilize the name, we herein designate a syntype male as the lectotype with the following label data: ‘Argentina, Mendoza, 25-11-1906 (November 25, 1906) // *Anthidium 20-punctatum* ♂ 1907 Friese det. // Type (red label) // Zool. Mus. Berlin // Lectotype *viginti-punctatum* ♂ Friese Des. V.H. Gonzalez & T. Griswold 2010’.

#### ANTHIDIUM WEYRAUCHI SCHWARZ, 1943

FEMALE, FIGS 6D, 206; MALE, FIGS 282, 409, 486, 563

*Anthidium weyrauchi* Schwarz, 1943: 2 (holotype: AMNH; ♀, Huaraz, Ancash, Peru).

**Diagnosis:** This species superficially resembles *A. adriani*, *A. rubripes*, and *A. sparsipunctatum* sp. nov. in body colour (black, with largely ferruginous legs, and T1–T4 with incomplete bands), the absence



of a tibial carina, hind basitarsus with unmodified hairs on the outer surface, and the sternal scopa black. The female can be separated from those species by the clypeus with distal margin thin (Fig. 6D) and T6 truncate, with depressed apical rim on the median third of the distal margin (Fig. 206). The male can be separated by the T7 with lateral lobe apically curved (Fig. 282), S4 without apical hair brush, and S6 with lateral spine short, blunt, and deep median emargination on distal margin (Fig. 409). Also, both sexes of this species have dark-brown wings with weak blue and violet reflections.

*Description: Female.* Body length 9.5 mm; forewing length 7.2 mm. *Structure.* Clypeus weakly convex, projected about 0.4× width of compound eye in profile, distal margin thin, straight, projecting as flat rim, as seen in profile, sublateral tubercles low (Fig. 6D); mandible with six teeth; labrum without basal protuberances, preapical projections large, distinctly curved upwards; F1 about as long as broad, slightly shorter (~0.9×) than combined lengths of F2 and F3. Tibial carina absent. T6 straight in profile, without distinct lateral angle, preapical carina minutely crenulate, depressed apical rim projecting on median one-third of truncate distal margin (Fig. 282). *Coloration.* Black, except: ferruginous on legs, excluding coxae, trochanters and bases of femora; yellow as follows: rounded spot laterally on vertex, T1–T4 each with lateral or sublateral spots (larger on T1, usually reduced on T3 and T4), and T5 with two submedian spots. Wings dark brown, including veins and stigma, distally with weak blue and violet reflections. *Pubescence.* Black, except ferruginous hairs on ferruginous areas of legs; whitish hairs on dorsum of mesosoma (intermingled with black hairs) and sides of metanotum and propodeum. Fore basitarsus with sparse fringe of long hairs ( $\geq 2\times$  basitarsal width) along posterior margin. *Sculpturing.* Propodeal triangle weakly shiny, finely lineolate to imbricate. T1–T5 with weakly elevated discal areas, weakly shiny between punctures (1–3× PW); depressed marginal zones with denser punctures than on discs (1–2× PW); distal margins shiny, narrow (1–2× PW), broader medially, and on T1.

*Male.* Body length 11.2 mm; forewing length 8.3 mm. *Structure.* Labrum without basal or preapical protuberances; F1 1.8× longer than broad, slightly shorter (0.8×) than combined lengths of F2 and F3. Lateral spine of T6 gently curved, about as long as median spine of T7; lateral lobe of T7 about as wide as or slightly narrower than distance between inner margin and median spine, apically curved (Fig. 282); S4 without apical brush, distal margin straight or nearly straight; S6, in ventral view, with straight basal margin, laterally with short, blunt ventrolater-

ally directed spine, with broad median emargination (~1.5× broader than deep) on median one-third of distal margin (Fig. 409); S7 hemisternite apically truncate (Fig. 486); S8 with rather long, distally bent (~70°), simple apical process, basally broad, about one-third width of distal margin (Fig. 563). Genitalia: gonostylus robust, about 3.0× longer than broad; volsella small, about one-third of gonostylar length, subrectangular in profile; penis valve about as long as gonostylus, rather narrow, apically pointed, blade-like, gently projected on median margin before curved apex, dorsoapical patch of hairs absent, medial projection large, distinct. *Coloration.* As in female, except yellow or cream on clypeus, except distal margin, inferior paraocular area, and outer surface of hind basitarsus (usually absent); maculations on terga more developed than in female. *Pubescence.* As in female, except whitish hairs on gena, posterior margin of fore femur, mesepisternum, disc of T1, and sides of T2 and T3. *Sculpturing.* Terga with distal margins broader than in female, about one-third width of depressed marginal zone.

*Distribution:* PERU: Ancash, Ayacucho, La Libertad. Recorded from the Sechura desert ecoregion.

*Phenology:* April, May.

#### PHYLOGENETIC RELATIONSHIPS

The analysis of the data matrix yielded 239 most parsimonious trees (MPTs) ( $L = 628$ ;  $CI = 18$ ;  $RI = 66$ ); 48 nodes collapsed in the strict consensus tree, and most branches were poorly supported by both bootstrap and Bremer values (Fig. 584). Two main clades can be recognized in *Anthidium*, one containing all strictly OW subgenera (*Gulanthidium*, *Nivanthidium*, *Proanthidium*, *Severanthidium*, and *Turkanthidium*), and one including the cosmopolitan *Anthidium s.s.* and the NW subgenus *Callanthidium*. The OW clade is supported by the following putative synapomorphies: axilla laterally carinate (character 29-1), and scutellum with truncate, carinate distal margin (31-1, 32-1) and greatly overhanging metanotum (33-1). *Turkanthidium* was the sister group of all remaining subgenera within that group. The second clade is supported by two synapomorphies: pronotal lobe rounded or nearly so, not carinate or lamellate (24-0), and the presence of a median spine on the distal margin of male T7 (70-1). Within this clade, the North African species *A. echinatum* was sister to the remaining *Anthidium* species, including *Callanthidium*. Some species groups that we have intuitively recognized were recovered in the analysis. These lineages are briefly discussed below.

*Emarginatum* group: This North American group includes *A. atripes*, *A. atripoides* sp. nov., *A. dammersi*, *A. emarginatum*, and *A. tenuiflorae*. It can be recognized by the absence of a hind tibial carina (tibial carina, hereafter), female T6 with depressed apical rim projecting on at least median half of distal margin, and male S4 with distinct apical brush of black hairs, and shape of male genitalia distinctive (as in Figs 47, 567). *Anthidium atrifrons*, *A. banningense*, *A. michenerorum* sp. nov., *A. palliventris*, and *A. platyfrons* sp. nov. seem also to belong to this group. The position of *A. rafaelli* within this group is unlikely.

*Espinosa* group: This distinctive South American group consists of three species (*A. espinosa*, *A. atacamense* sp. nov., and *A. nigerrimum*) with a median spine on distal margin of female T6 and male T7 apically narrowed, with lateral lobes close together beneath median spine.

*Funereum* group: The four species included in this group (*A. funereum*, *A. peruvianum*, *A. spatulatum* sp. nov., and *A. toro*) can be recognized by the following combination of characters: tibial carina absent; female with strong basal projections on the labrum (clearly visible even when mandibles are closed), and T6 with distinct lateral and submedian spines; male with S4 medially notched on distal margin, and T7 with narrow, apically curved lateral lobes. This group seems to be related to *A. weyrauchi* and *A. multispinosum* sp. nov.

*Latum* group: This South American group includes *A. insignissimum*, *A. latum*, and *A. meloi* sp. nov. It can be recognized by the presence of a tibial carina, clypeal margin strongly tuberculate in the female, and shape of S8 (Figs 521, 524, 530) and genitalia in the male (Fig. 570).

*Maculosum* group: This monophyletic group includes *A. andinum*, *A. chamelense* sp. nov., *A. maculosum*, *A. parkeri* sp. nov., and *A. rodriguezi*. All females have distinctly flat faces with dull, coarse, and sparsely punctate integument covered with simple, apically curly or hooked hairs (Fig. 5E); the tibial carina is present, and T7 of the male is spiniform or digitiform. All species occur in North and Central America, except for *A. andinum*.

*Porterae* group: This group includes *A. aztecum*, *A. hallinani*, *A. maculifrons*, *A. macushi* sp. nov., *A. porterae*, and *A. sanguinicaudum*. The species of this group are found from northern South America to south-western North America, except for *A. maculifrons*, which reaches central and south-eastern areas of the USA. Two other species, *A. cochimi* and *A. quet-*

*zalcoatli*, might also belong to this group given the similarities in the female T6 and male genitalia, but analyses showed them to be closer to *A. sonorensis*. The South African species *A. pontis* was included in this group, but such a position seems unlikely.

#### CHARACTER EVOLUTION

Based on the analysis, the modified hairs of the female clypeus (character 7), present in 21 NW species (23%), represent multiple independent origins in the NW *Anthidium* s.s. (Fig. 585). The dull, coarse and sparsely punctate integument of the female frons (character 13) seems to have independently evolved in the Maculosum group, and in *A. calchaqui* sp. nov. and related species (not shown). Females of all these species also have distinctly flat faces, as in Figure 5E. We obtained the same results when excluding characters 7 and 13 from the analysis or using fast optimization (ACCTRAN), which favours character reversals over convergences. The tomentum on the outer surface of the fore basitarsus has independently evolved in *Anthidium*, and has been lost several times and gained in some species (Fig. 585). A similar pattern of gains and losses seems to have occurred with the hind tibial carina (Fig. 585).

#### DISCUSSION

##### SPECIES HYPOTHESES

We have tested species hypotheses based on the study of thousands of specimens (> 20 000), an exhaustive comparative analysis of adult external morphological characters of both sexes, and, when available, patterns of geographic distribution. Such study not only allowed us to recognize several new species and clarify the status of others, but also to have a better idea of the diversification of these bees in the NW. We were also able to evaluate the congruence of some characters previously used by many authors in the species recognition of *Anthidium* (e.g. body pubescence and integumental colour), in the light of more detailed structural characters. The punctuation and sculpture of the terga, structures of the clypeal margin, and last tergum of the female, as well as T7, genitalia, and hidden sterna of the male, have in most cases proved reliable characters in species recognition. Despite this, many questions remain regarding the limits of some species, especially from South America, where large areas remain to be surveyed and several species are only known from the holotype or at best a small number of specimens. For example, *A. decaspilum* and *A. funereum*, as here understood, are species highly variable morphologically, and each may contain several distinct species. We were unable to reliably separate them based on the morphological analysis

**Table 3.** New World *Anthidium* species known from a single sex

Taxon	Known sex	Elevation	Countries recorded
<i>A. alsinai</i>	♂	3860 m a.s.l.	Peru (Puno)
<i>A. igori</i> *	♂	2800–3000 m a.s.l.	Peru (Ancash, La Libertad, Lima)
<i>A. isabelae</i>	♀	–	Brazil (Santa Catarina)
<i>A. larocai</i>	♀	~500 m a.s.l.	Brazil (Mato Grosso)
<i>A. luizae</i>	♀	3400 m a.s.l.	Peru (Ayacucho)
<i>A. masunariae</i>	♀	~3200 m a.s.l.	Peru (Junín)
<b><i>A. multispinosum</i> sp. nov.</b>	♀	1172 m a.s.l.	Mexico (Durango)
<i>A. neffi</i> sp. nov.	♀	924 m a.s.l.	Argentina (Neuquén)
<i>A. paitense</i>	♂	2000–2030 m a.s.l.	Peru (Lima, Piura)
<i>A. rozeni</i> *	♂	2800 m a.s.l.	Peru (Lima)
<i>A. tarsoi</i>	♀	2800 m a.s.l.	Peru (Lima)

\*The females of these species were described by Urban (2002), each based on a specimen from Canta, Peru; however, their identity remains to be confirmed. We were not able to examine the female of *A. rozeni*, whereas that of *A. igori* seems to be conspecific with *A. tarsoi* (see species accounts).

and the limited amount of material examined; a similar case may occur in *A. atrifrons* in North America (see species account). Sex associations also need to be confirmed in some species. To date, 11 species are known from a single sex (Table 3), and some nominal species might be the unknown sex of others. For example, we were inclined to render *A. tarsoi* (known from the female) as a subjective junior synonym of *A. igori* (known from the male), but declined to take such an action given that *A. rozeni*, a presumably related species, is also known only from the male holotype. All three species are known from the same type locality or nearby areas in Peru.

Further studies including larger samples of specimens from different localities and using molecular characters, such as DNA barcodes, may improve the taxonomic resolution of these species. DNA barcodes are increasingly valuable tools in taxonomy, especially in diverse, morphologically monotonous taxa. An excellent example worth mentioning is the recent work on the metallic species of *Lasioglossum* subgenus *Dialictus* from Canada (Gibbs, 2010).

#### PHYLOGENY AND BIOGEOGRAPHY

Excluding the monotypic subgenus *Nivanthidium*, and perhaps *Gulanthidium* (represented by a single species in the analyses), all subgenera of *Anthidium* appear monophyletic, except for *Anthidium* s.s., which is rendered paraphyletic by *Callanthidium* (Fig. 584). According to our analysis, both species placed in the latter subgenus, *A. formosum* and *A. illustre*, are clearly derived species of *Anthidium* s.s., just as are other distinctive species (i.e. *A. espinosai*, *A. latum*, and *A. rodriguezi*) previously given subgeneric status. Thus, to recognize only monophyletic

groups, we here synonymize *Callanthidium* with *Anthidium* s.s. (see above). The sister-group relationship between *Callanthidium* and *A. michenerorum*-sp. nov., and with both and *A. platyfrons* sp. nov., seems unlikely. No single synapomorphy supports such relationships, and the clades had low Bremer and bootstrap values (1–2 and < 50%, respectively). In fact, judging by the shape of S6, S8, and the genital capsule of the male, those species seem to be closer to the Emarginatum species group than to *Callanthidium*. Although several species groups that we have intuitively recognized were recovered in the analyses, some species that are morphologically similar and are likely to be sister taxa never grouped with them. For example, *A. utahense* and *A. jocosum* are nearly identical in the T6 of the female and T7, genitalia, and associated sterna of the male, and we do not doubt that they are sister taxa. Likewise, *A. edwardsii*, *A. pallidiclypeum*, and *A. placitum* share several features in both sexes that clearly indicate a close relationship (e.g. clypeus with wide angled median emargination on distal margin), but they appeared in different positions in the terminal branches of the strict consensus tree. Molecular data may prove helpful in resolving these questions.

All *Anthidium* subgenera restricted to the OW belong to a clade that is sister to the widely distributed *Anthidium* s.s. The latter subgenus is morphologically diverse and is found on all continents, except Australia, but is absent from the Indo-Malayan tropics (Michener, 2007). Griswold & Michener (1988) noted that several NW species possess a hind tibial carina, as in most Palaearctic *Anthidium* s.s. The function of this carina is unknown. It is present in diverse taxa of Anthidiini [*Icteranthis* Michener, 1948, *Euasps* Gerstaecker, 1857, and *Eoanthidium*



Popov, 1950 (subgenus *Clistanthidium* Michener & Griswold, 1994)]. Griswold & Michener (1988) also noted that the male T7 in some South American species (e.g. *A. latum*) has a submedian spine, as in Palaearctic species such as *Anthidium cingulatum* Latreille, 1809. Thus, the presence of those characters in some NW species might indicate a Palaearctic origin. In addition, similarity in the overall appearance of some species, namely *A. latum*, to some Palaearctic species is such that early renowned bee taxonomists, including H. Friese, thought this Brazilian species was introduced from Europe (Moure & Urban, 1964). When we map the presence of the tibial carina in the consensus tree, it appears to have evolved independently in *Anthidium s.s.*, and in the clade containing *Gulanthidium*, *Nivanthidium*, and *Severanthidium*. It also seems to have been secondarily lost in many species and gained only once in the Maculosum and Porterae clades in the NW (Fig. 585). These results show the plasticity of the tibial carina in *Anthidium*, and present a cautionary statement on the extent to which inferences on species relationships can be made on the basis of a single or few characters.

Although we included only a few OW species in our analysis, it is interesting that they appear in different positions in the tree among the NW species: *A. echinatum* is found on a basal branch as the sister group of all NW taxa, whereas the other three are located on terminal branches. Thus, our analysis supports the idea of a Palaearctic origin, and suggests the non-monophyly of NW *Anthidium*. Most South American *Anthidium* occur at high altitudes in the Andes and, as has been hypothesized for other bees of Holarctic origin occurring in South America, including *Bombus* Latreille, 1802 (e.g. Gonzalez & Engel, 2004; Hines, 2008), and many other insect taxa (reviewed by Morrone, 2006), it is reasonable to assume a southwards migration of some Nearctic elements to South America, entering via the Central American land bridge once it formed during the Pliocene, about 3 Mya, or even earlier. Two putative *Anthidium* fossils from the Eocene–Oligocene epoch (~33 Mya) in North America agree with this scenario (Engel & Perkovsky, 2006). If the South American fauna is in fact derived from Nearctic elements, one might expect them to occupy terminal branches in the consensus tree. Although the relationships among species within *Anthidium s.s.* are not well resolved in the consensus tree, our results seem to support this view, except for the basal position of the Latum group. Thus, a non-Nearctic origin of the South American fauna might be possible. As in the NW, the subgenus *Anthidium s.s.* in the OW is morphologically highly diverse. Thus, there is no question that further analyses including a larger number of species from other regions of the

world, as well as additional characters, are required to gain a better understanding of the origins of the NW fauna.

#### EVOLUTION OF MORPHOLOGICAL ADAPTATIONS ASSOCIATED WITH FORAGING

##### *Pollen from nototribic flowers*

Some pollen wasps (Vespidae) and bees have independently developed a series of morphological and behavioural adaptations to collect pollen from nototribic flowers. Nototribic pollination is exhibited by plants of the families Lamiaceae, Fabaceae, and Plantaginaceae, and occurs in bilateral flowers, in which the filaments and styles are located along the adaxial (dorsal) side (Müller, 1996a, b). When a bee, wasp, or bird visits a flower, the pollen is deposited onto its head, back, or bill. Morphological adaptations on the faces of bees include distinctly flat areas of the face, rugose integument, and stiff, proclinate, hooked, or wavy hairs (Müller, 1996a, b). More than 80 species in 23 genera belonging to five of the seven bee families, but mostly in Apidae and Megachilidae, possess such adaptations (V.H. Gonzalez, T. Griswold, M.G. Rightmyer & C. Hunt, unpubl. data).

We found two types of morphological specialization in *Anthidium* for pollen collecting from nototribic flowers. The first (type I) consists of modified hairs only (i.e. curved, wavy, or hooked), usually on the clypeus and sometimes on the supraclypeus; these areas of the face are unmodified, gently convex, with dense punctures among smooth and shiny integument. The second morphological modification (type II) includes similar modifications of hairs as found in type I in combination with a distinctive integument on the entire face. The face in species with this type of modification is distinctly flat, with dull, coarse, and sparsely punctate integument (Fig. 5D, E). Based on this study, type I seems to have independently evolved in several NW species. It is also more common than type II, and is present in numerous OW *Anthidium s.s.* species: *Anthidium christianseni* Mavromoustakis, 1956, *Anthidium cingulatum* Latreille, 1809, *Anthidium dalmaticum* Mocsáry, 1884, *Anthidium florentinum* (Fabricius, 1775), *Anthidium loti* Perris, 1852, *A. manicatum*, *Anthidium pullatum* Morice, 1916, *Anthidium septemspinum* Lepeletier, 1841, and *Anthidium taeniatum* Latreille, 1809. In contrast, type II has evolved only once in the Maculosum group and, perhaps independently, in *A. calchaqui* sp. nov. and related species. So far, we have not found any OW species with this type of modification. Type II may have evolved fewer times because it involves more structural modifications than type I.

Little is known about the foraging behaviour of these bees on nototribic flowers, but scant

observations of other unrelated bee species suggest some behavioural adaptations in how they harvest the pollen from the flower and remove it from the body, especially on those with type II (e.g. Müller, 1996a; Gonzalez, Mantilla & Palacios, 2006). The foraging habits for most *Anthidium* species remain unknown, but assuming that species with type I are less polylectic than those with normal hairs on the face, and that those with type II are even more specialized than type I, our analysis would suggest switches from polylecty to oligolecty in the genus. However, transitions from oligolecty to polylecty are also possible, as oligolecty seems to be the ancestral state in bees (e.g. Müller, 1996b; Danforth *et al.*, 2006; Praz, Müller & Dorn, 2008).

#### *Exudates from extrafloral trichomes*

Females of some species in closely related wool-carder bee genera possess a dense tomentum covering the outer surface of the basitarsus, usually of all legs: *Afranthidium* Michener, 1948 (subgenera *Afranthidium*, *Immanthidium* Pasteels, 1969, and *Oranthidium* Pasteels, 1969), *Anthidium*, *Pseudoanthidium* (subgenus *Micranthidium* Cockerell, 1930), and the monotypic *Gnathanthidium* Pasteels, 1969 (V.H. Gonzalez & T.L. Griswold, unpubl. data). Based on observations on *A. manicatum* (Müller *et al.*, 1996), the tomentum helps to absorb extrafloral trichome secretions, which are then added to the plant hairs used for cell construction. These plant secretions might facilitate trichome manipulation, but also waterproof the cell and could prevent microbial attacks. Our analyses suggest that in *Anthidium* this tomentum is independently evolved in the subgenera *Proanthidium*, in the clade composed of *Nivanthidium* and *Severanthidium*, and in *Anthidium* s.s. Like other characters mapped onto the phylogeny, the tomentum has been secondarily lost in some species, and has been gained a few times in others (Fig. 585). There is great variation in the presence of tomentum among species. It is usually present on the fore and mid basitarsi, but in some species, such as *A. deceptum*, it is also found on the hind basitarsus. The tomentum can be completely absent from the mid and hind basitarsi, as in *A. edwini* and *Gnathanthidium prionognathum* (Mavromoustakis, 1935). In some species, such as *Anthidium niveocinctum* Gerstaecker, 1857, the tomentum is long and dense, whereas in others, such as in *A. dammersi* and *A. parkeri* sp. nov., it is short and sparse, barely covering the integument. Behavioural studies of additional *Anthidium* species are needed to determine whether secretions are collected even in the absence of tomentum.

Our inferences on the evolution of the morphological adaptations associated with foraging discussed here may be biased. We had a limited out-group taxon sampling, and the chosen taxa might not be the

closest relatives of *Anthidium* (e.g. Gonzalez *et al.*, 2012), thus casting doubts on the number of origins and losses of the mapped characters. For instance, we only used a single species of *Afranthidium* as the close out-group taxon, and two Palearctic species of *Anthidium* s.s., only one of them with modified hairs on the face and tomentum on basitarsus (i.e. *A. manicatum*). The genus *Afranthidium*, from which *Anthidium* might have evolved (Michener, 2007), is a large and diverse group containing more than 50 species (Ascher & Pickering, 2012) in 11 subgenera. The single species included in our analyses thus may not be the subgenus most closely related to *Anthidium*. In addition, some species of *Afranthidium* subgenus *Immanthidium*, as well as of *Pseudoanthidium* subgenus *Micranthidium*, also have type-I modifications on the face and tomentum on basitarsi (V.H. Gonzalez T. Griswold, M.G. Rightmyer & C. Hunt, unpubl. data). For practical reasons we did not include representatives of all genera of Anthidiini and subgenera of *Afranthidium*, although out-group species were chosen based on specimen availability and the exploratory phylogenetic analyses of Müller (1996b) and Gonzalez (2008). Thus, when the relationships among the genera of Anthidiini and subgenera of *Afranthidium* are studied in detail, further analyses using different out-groups may be desirable.

#### BIODIVERSITY

*Anthidium* occupies most of the Western Hemisphere, from 65.3°N to 50.4°S, and from below sea level in Death Valley, California, USA, to 3658 and 4233 m a.s.l. in North and South America, respectively. *Anthidium* is most diverse in xeric and mesic environments (Fig. 586), resulting in a general increase in diversity from east to west on both the North and South American continents. In North America, *Anthidium* is most diverse in the hot and cold deserts, with the apparent greatest diversity in the Great Basin (24 species, 62% of the native North American fauna). This may, to some extent, be an artifact resulting from a combination of greater collecting effort and inclusion of montane species at the boundaries where the Great Basin abuts on the Sierra Nevada to the west and the Rocky Mountains to the east; however, the Colorado Plateau, another cold arid region, also has high diversity compared with the hot deserts (23 compared with 17–22 species). The more northerly arid ecoregions of the Snake–Columbia and Wyoming Basin shrub steppe have reduced diversity. *Anthidium*, unlike a number of other bee genera that have their greatest diversity in the mediterranean and montane climates of cismontane California (e.g. *Chelostoma*, *Dufourea*, and *Panurginus*), is not as diverse in this mesic environment as it is in xeric

regions. Boreal and tropical environments are depauperate, as is rapidly the case with increasing distance to the east of the Rocky Mountains cordillera. The influence of collecting effort on presumed patterns cannot be ignored; however, collecting effort per ecoregion, as measured by number of specimens, is not a good predictor of richness.

We know far less about the biodiversity patterns of South American *Anthidium*. As with North America, xeric regions are particularly diverse. Ecoregions on the western flank of the Andes (Central Andean dry puna, Sechura Desert, and Central Andean puna) appear more diverse than the High and Low Monte and Patagonian steppe of the eastern side. Here, the influence of collecting effort is more likely to obscure patterns. In contrast to North America, the mediterranean Chilean matorral ecoregions appear equally diverse to xeric regions in Chile and southern Peru.

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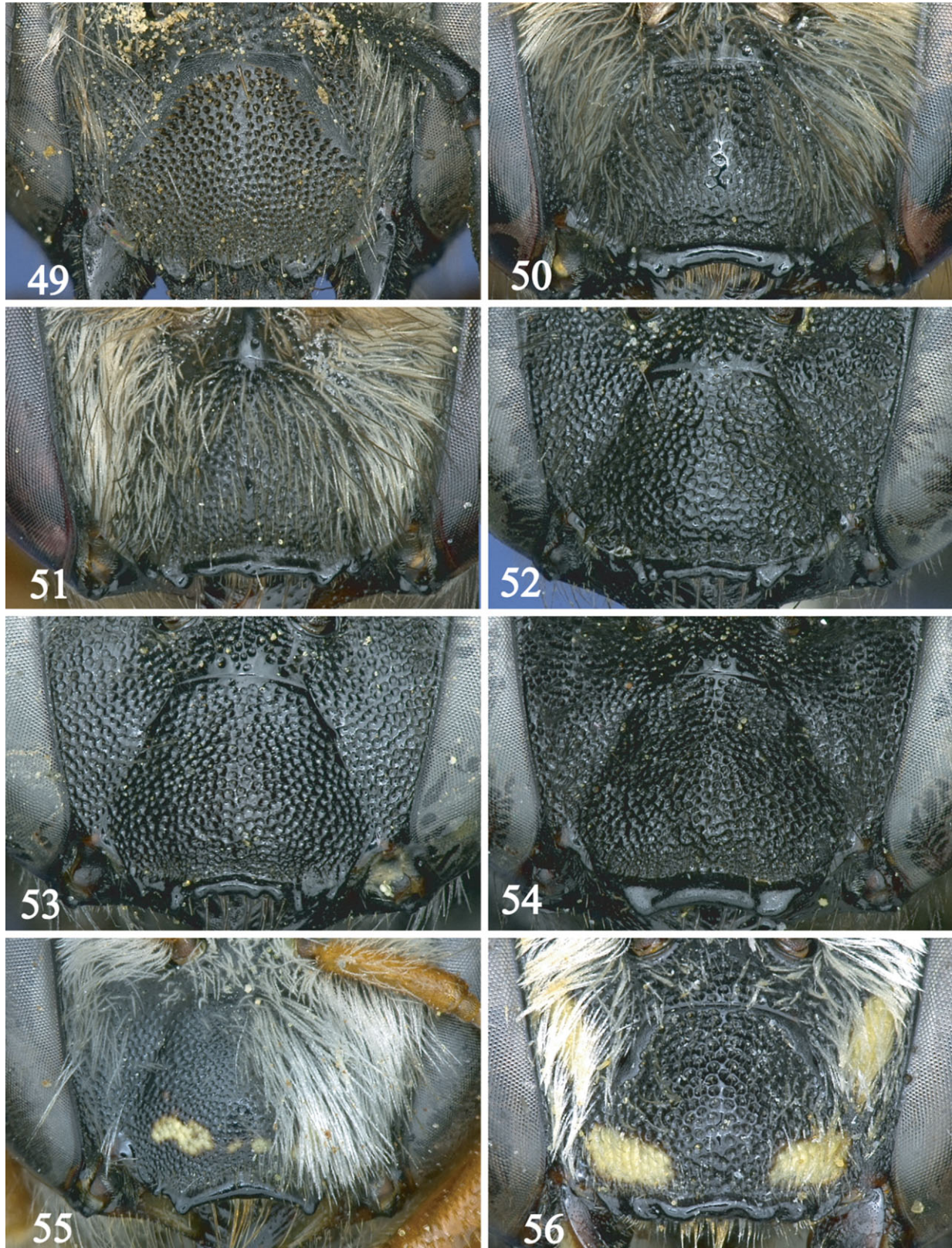
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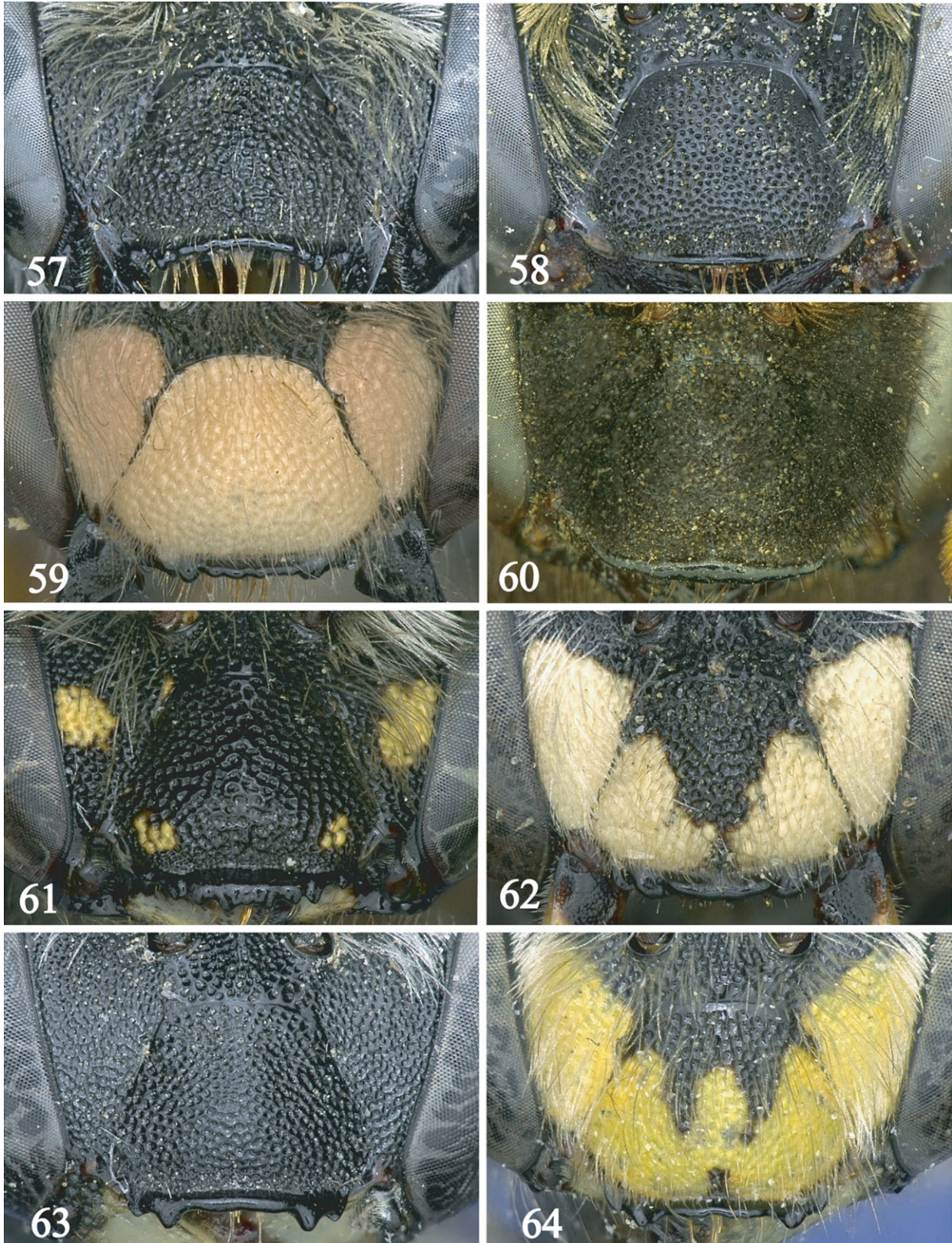
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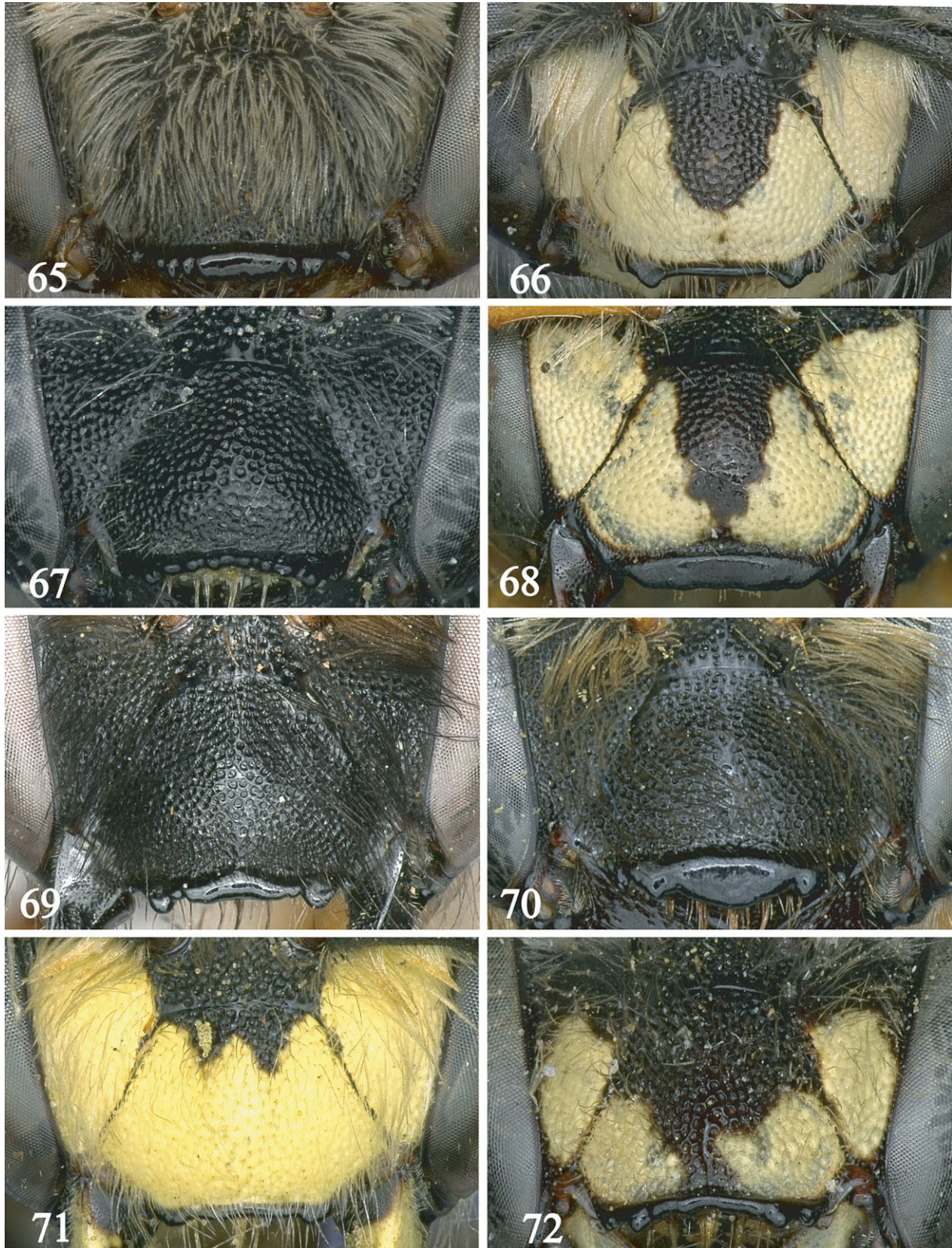
**Figures 49–56.** Clypeus of *Anthidium* females: 49, *Anthidium andinum*; 50, *Anthidium anurospilum*; 51, ***Anthidium atacamense** sp. nov.*; 52, *Anthidium atrifrons*; 53, *Anthidium atripes*; 54, ***Anthidium atripoides** sp. nov.*; 55, *Anthidium aymara*; 56, *Anthidium aztecum*.





**Figures 57–64.** Clypeus of *Anthidium* females: 57, *Anthidium banningense*; 58, *Anthidium chamelense* sp. nov.; 59, *Anthidium chilense*; 60, *Anthidium chubuti*; 61, *Anthidium clypeodentatum*; 62, *Anthidium cochimi*; 63, *Anthidium cockerelli*; 64, *Anthidium collectum*.





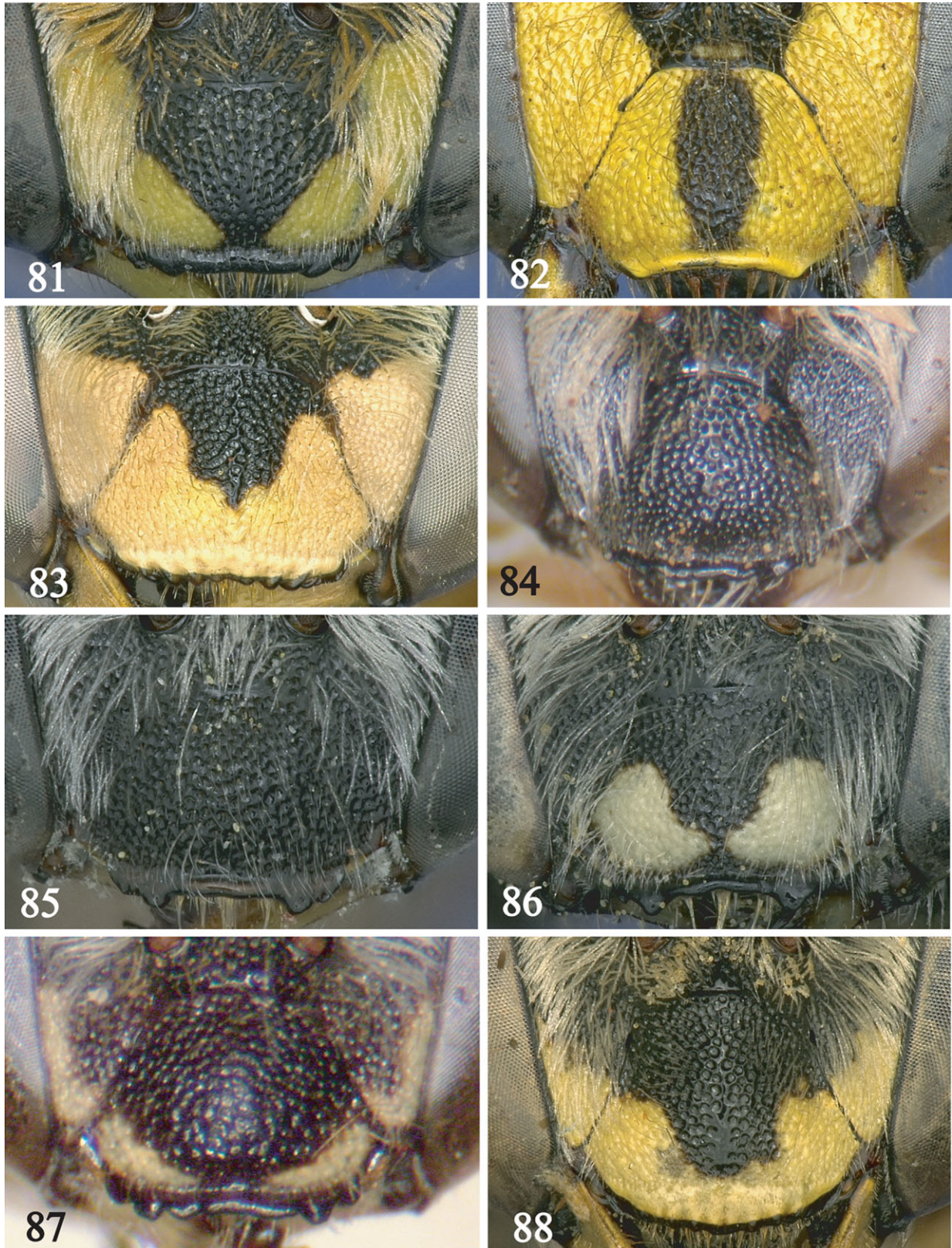
**Figures 65–72.** Clypeus of *Anthidium* females: 65, *Anthidium colliguayanum*; 66, *Anthidium cuzcoense*; 67, *Anthidium dammersi*; 68, *Anthidium danieli*; 69, ***Anthidium danunciae* sp. nov.**; 70, *Anthidium decaspilum*; 71, *Anthidium deceptum*; 72, ***Anthidium duomarginatum* sp. nov.**





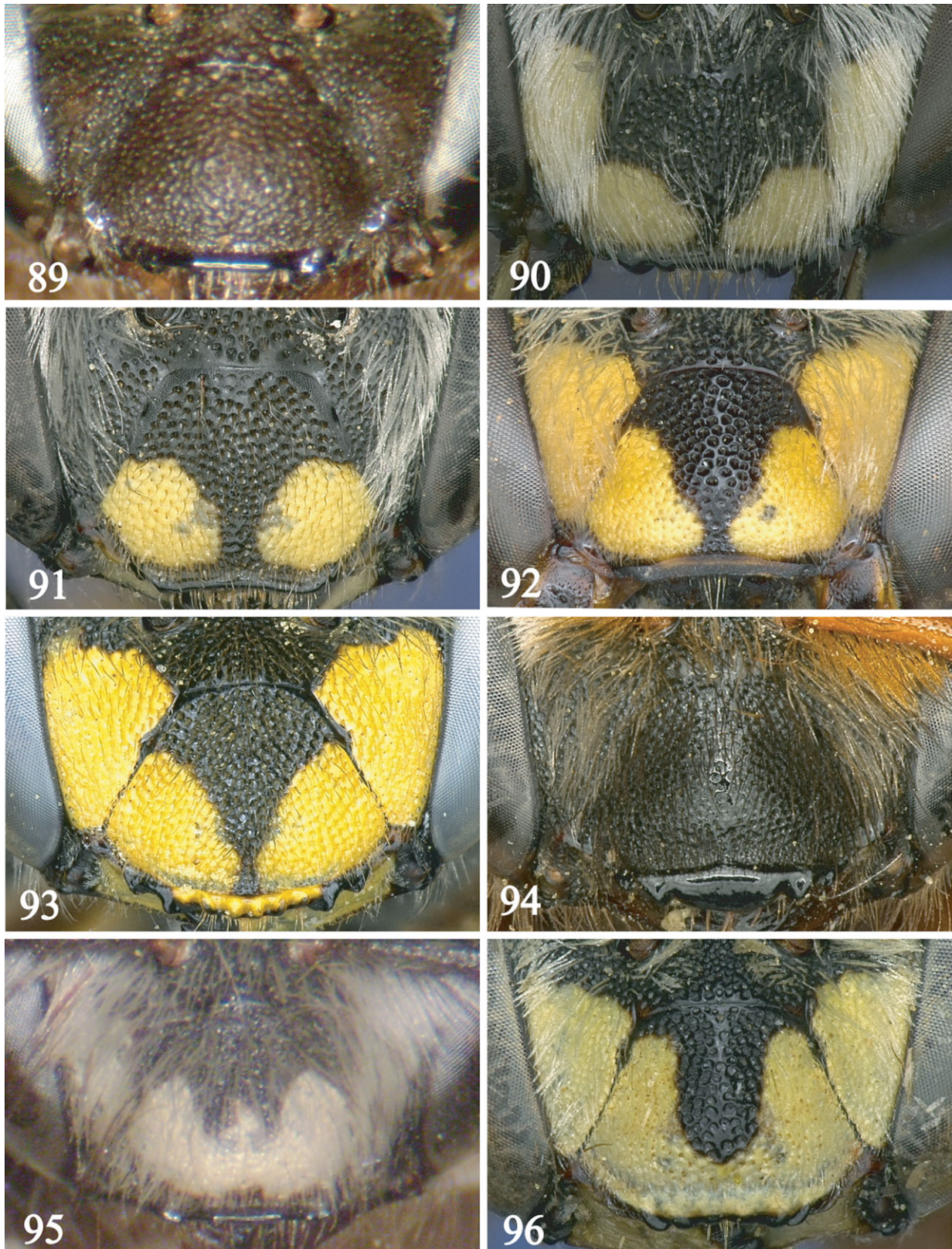
**Figures 73–80.** Clypeus of *Anthidium* females: 73, *Anthidium edwardsii*; 74, *Anthidium edwini*; 75, *Anthidium emarginatum*; 76, *Anthidium espinosai*; 77, *Anthidium formosum*; 78, *Anthidium friesei*; 79, *Anthidium funereum*; 80, *Anthidium gayi*.





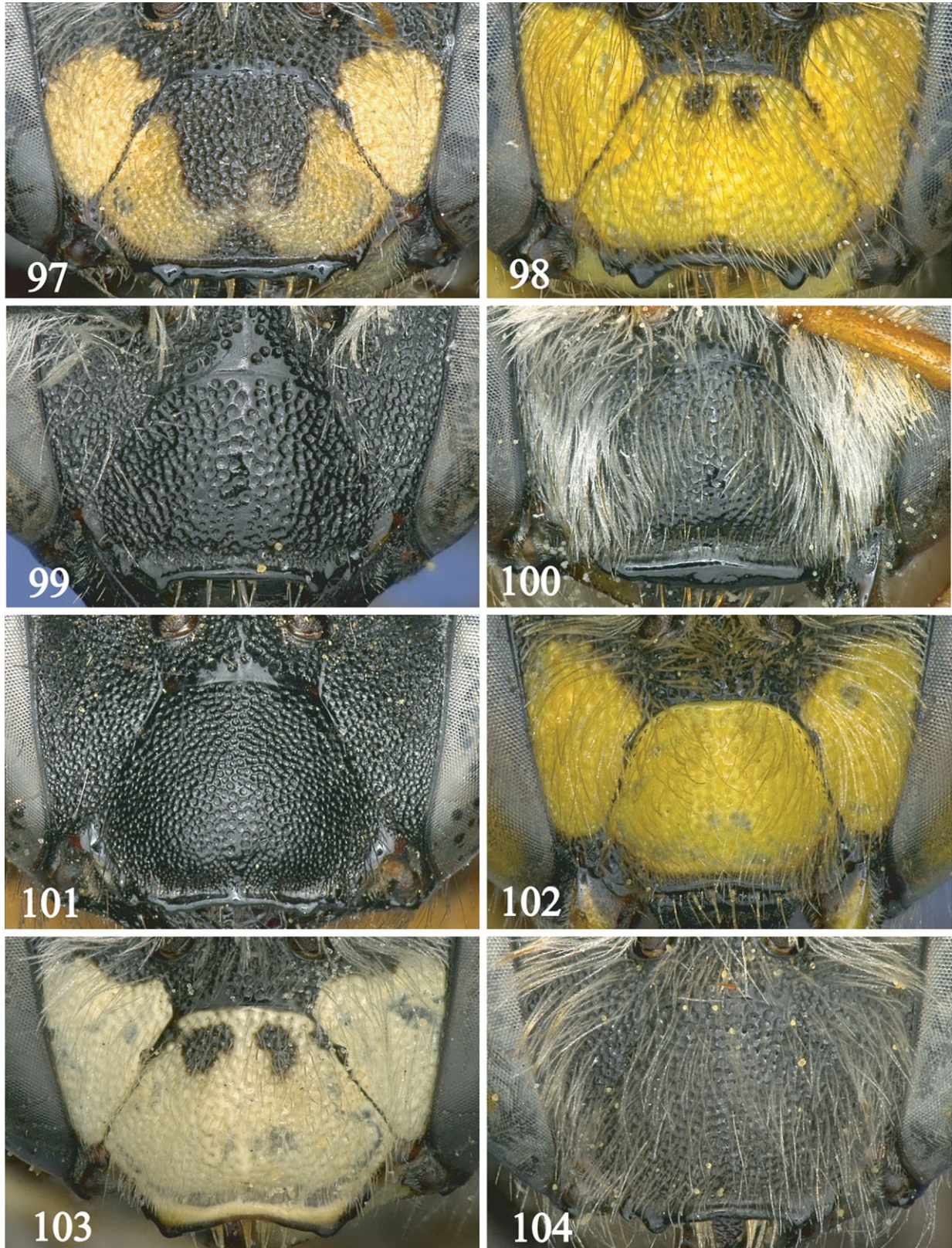
**Figures 81–88.** Clypeus of *Anthidium* females: 81, *Anthidium hallinani*; 82, *Anthidium illustre*; 83, *Anthidium insignissimum*; 84, *Anthidium isabelae*; 85, *Anthidium jocosum*; 86, ***Anthidium labergei* sp. nov.**, 87, *Anthidium larocai*; 88, *Anthidium latum*.





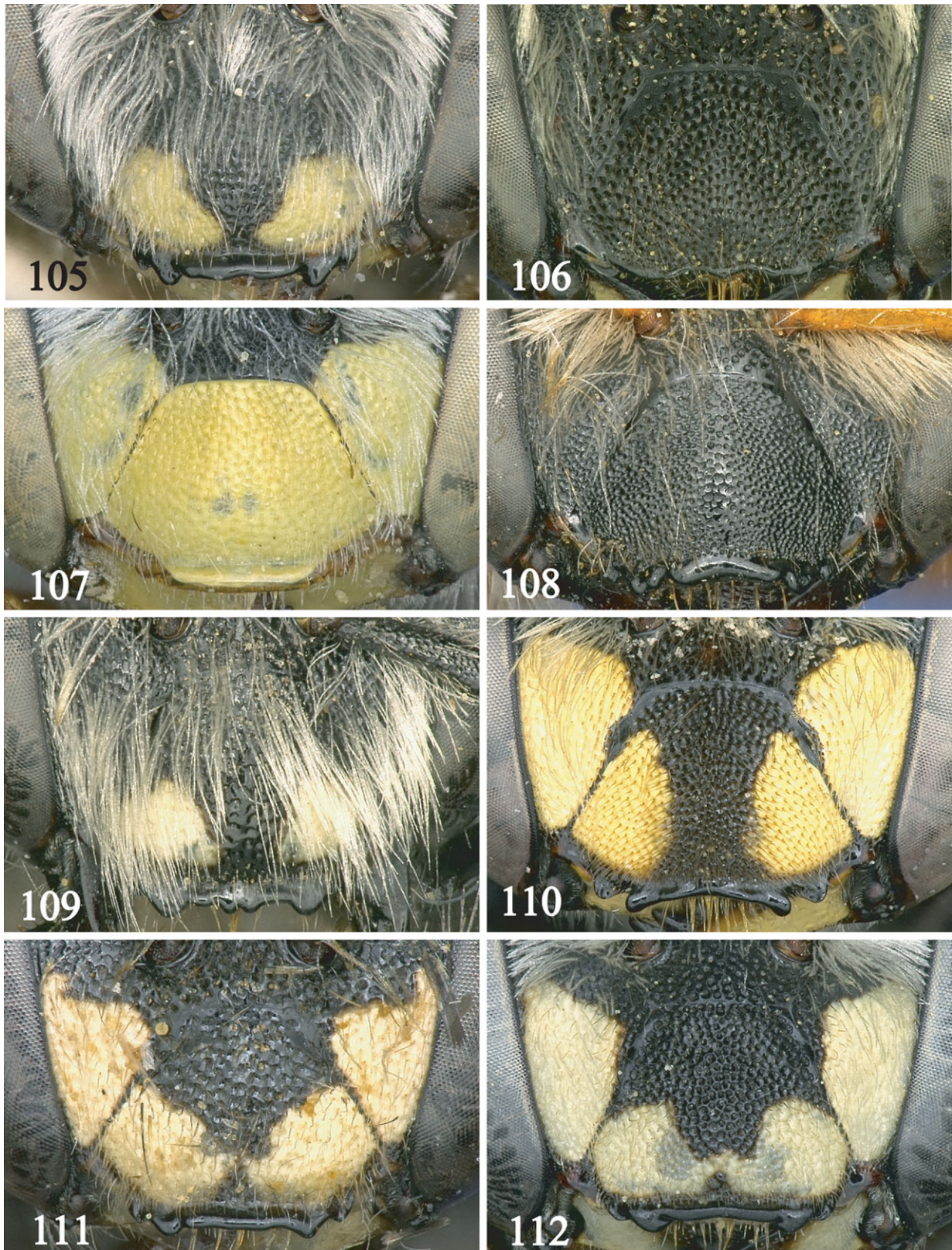
**Figures 89–96.** Clypeus of *Anthidium* females: 89, *Anthidium luizae*; 90, *Anthidium maculifrons*; 91, *Anthidium maculosum*; 92, ***Anthidium macushi* sp. nov.**; 93, *Anthidium manicatum*; 94, ***Anthidium mapuche* sp. nov.**; 95, *Anthidium masunariae*; 96, ***Anthidium meloi* sp. nov.**





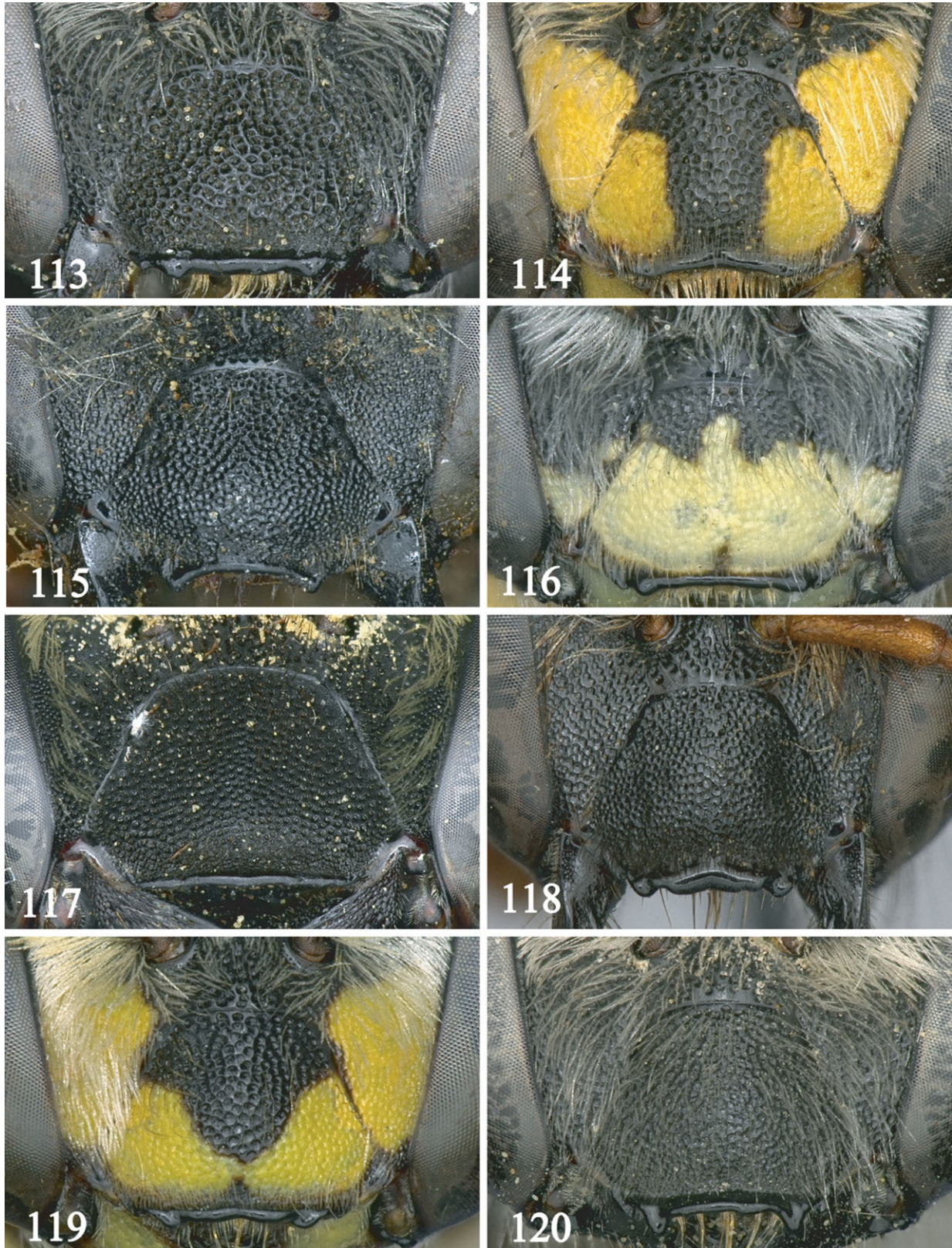
**Figures 97–104.** Clypeus of *Anthidium* females: 97, *Anthidium michenerorum* sp. nov.; 98, *Anthidium mormonum*; 99, *Anthidium multispinosum* sp. nov.; 100, *Anthidium neffi* sp. nov.; 101, *Anthidium nigerrimum*; 102, *Anthidium oblongatum*; 103, *Anthidium pallidiclypeum*; 104, *Anthidium palliventre*.





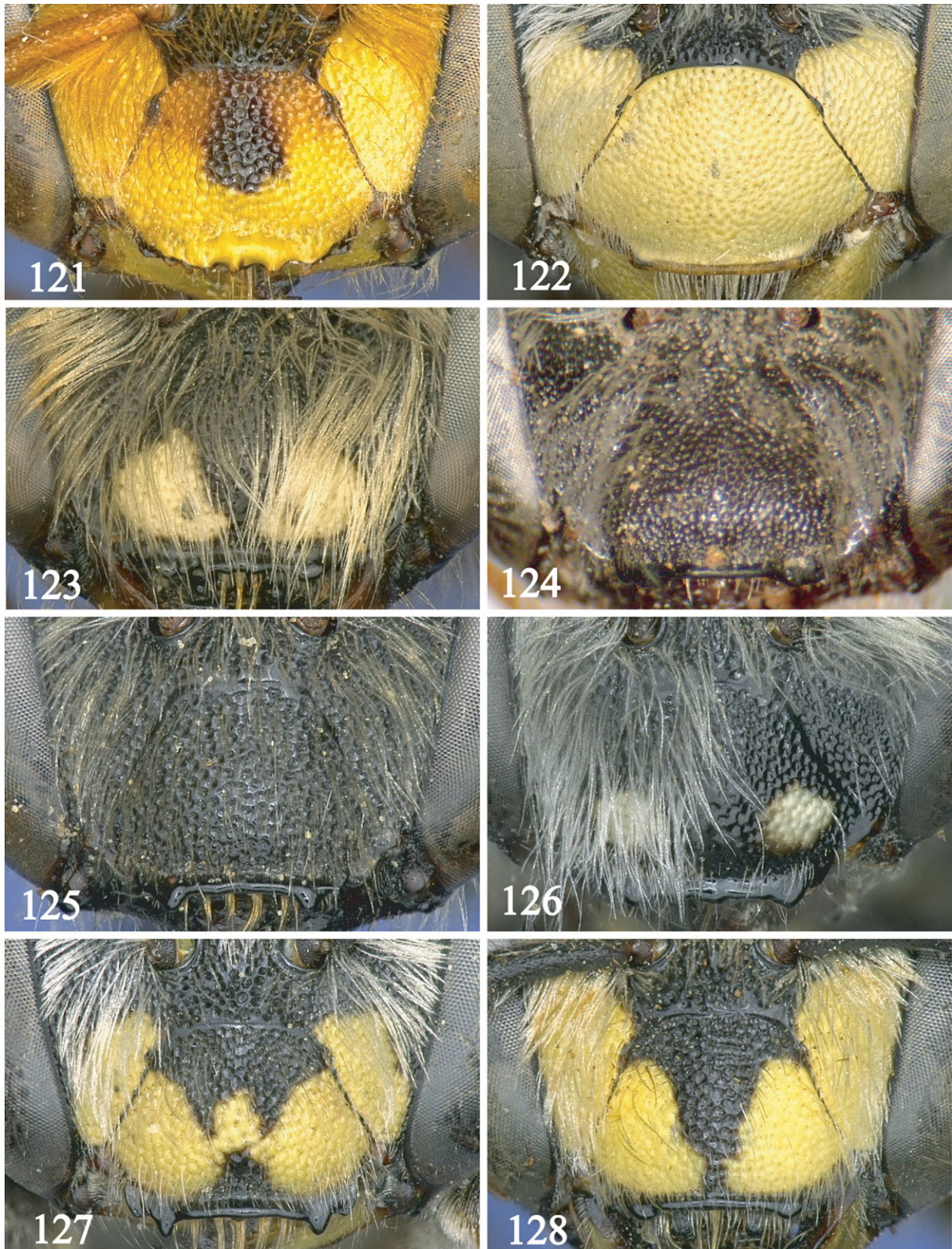
**Figures 105–112.** Clypeus of *Anthidium* females: 105, *Anthidium palmarum*; 106, *Anthidium parkeri* sp. nov.; 107, *Anthidium paroselae*; 108, *Anthidium penai*; 109, *Anthidium peruvianum*; 110, *Anthidium placitum*; 111, *Anthidium platyfrons* sp. nov.; 112, *Anthidium porterae*.





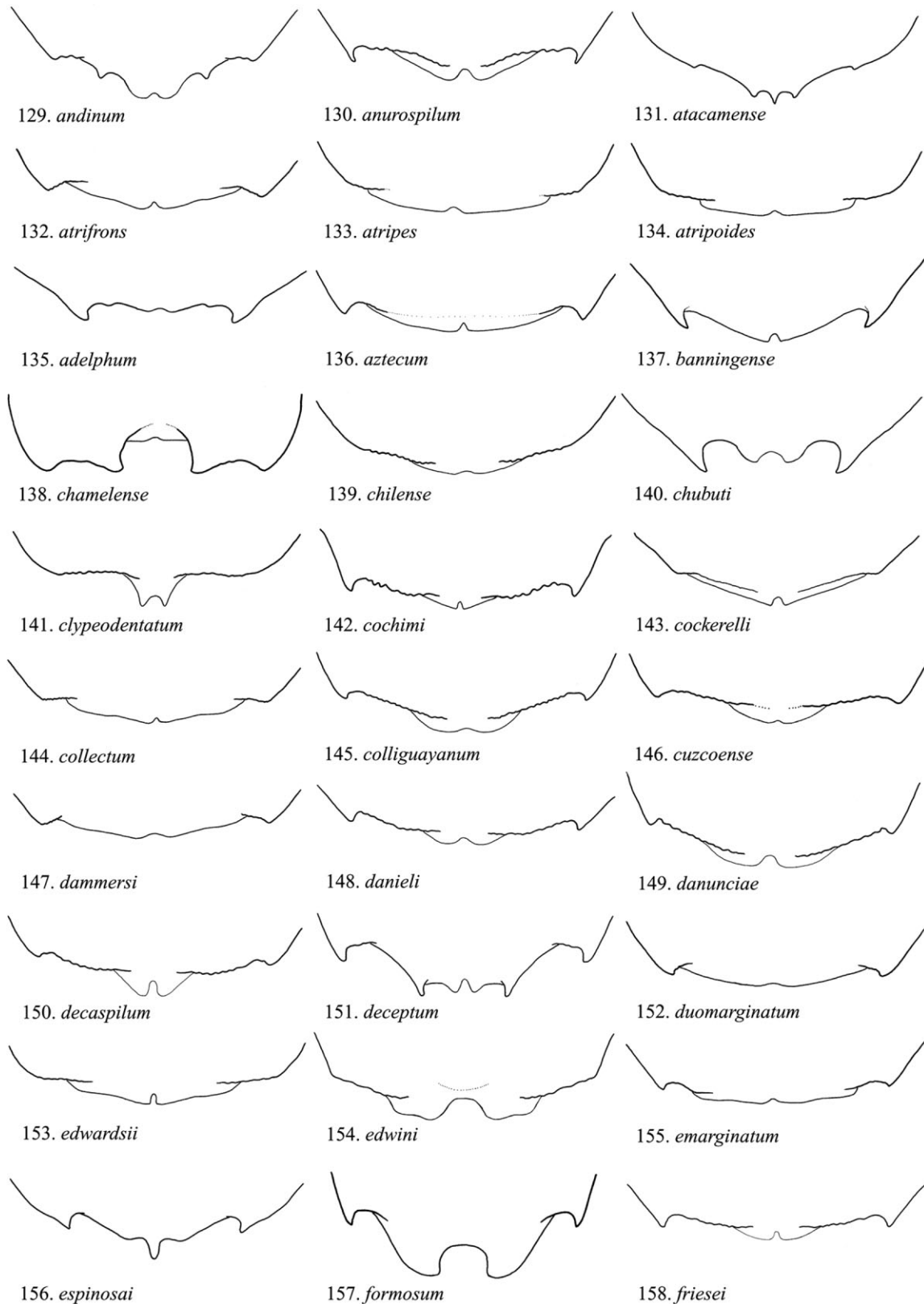
**Figures 113–120.** Clypeus of *Anthidium* females: 113, *Anthidium psoraleae*; 114, *Anthidium quetzalcoatli*; 115, *Anthidium rafaelli*; 116, *Anthidium rodecki*; 117, *Anthidium rodriguezi*; 118, *Anthidium rubripes*; 119, *Anthidium sanguinicaudum*; 120, *Anthidium schwarzi* sp. nov.



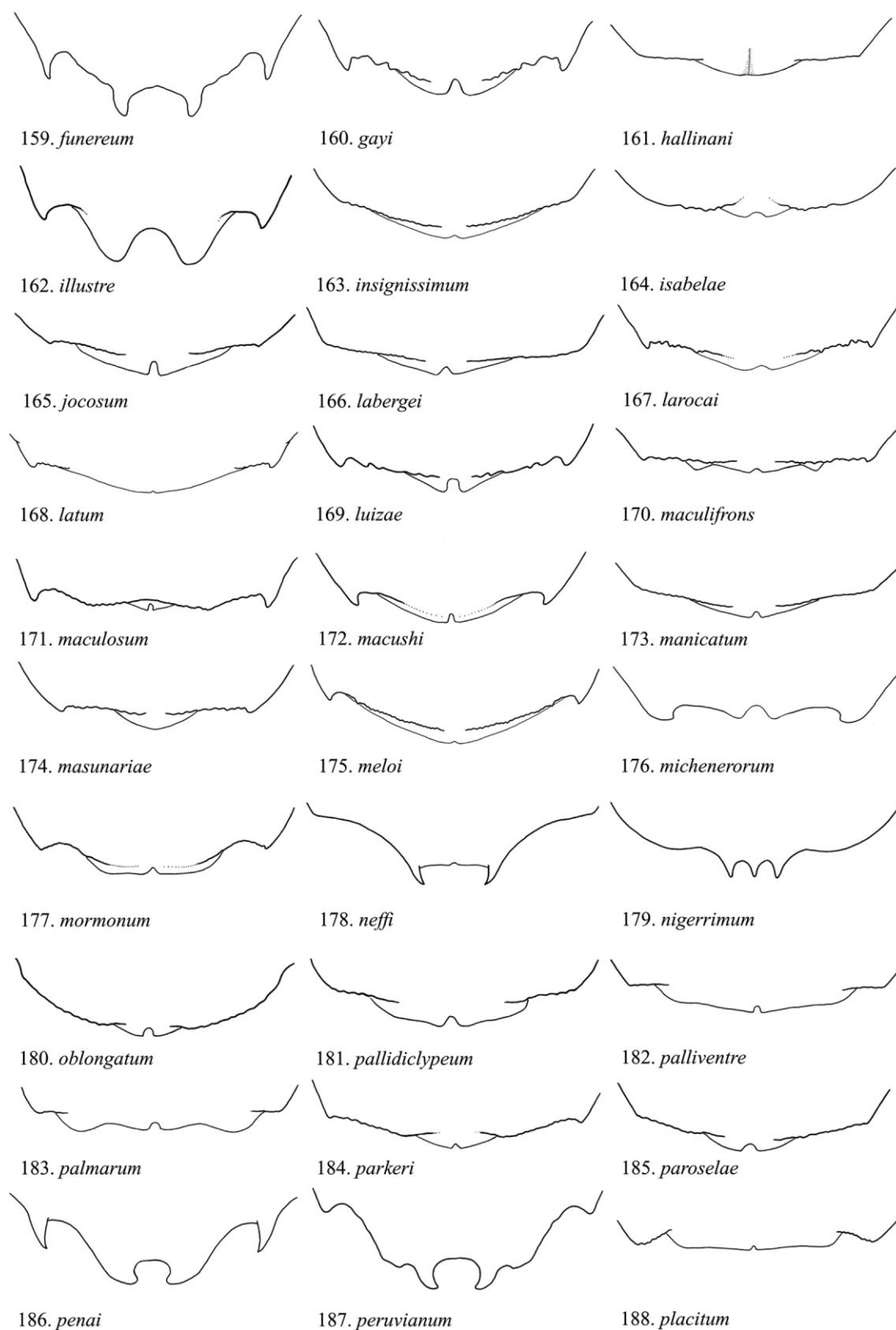


**Figures 121–128.** Clypeus of *Anthidium* females: 121, *Anthidium sertanica*; 122, *Anthidium sonorensis*; 123, *Anthidium spatulatum* sp. nov.; 124, *Anthidium tarsoi*; 125, *Anthidium tenuiflorae*; 126, *Anthidium toro*; 127, *Anthidium utahense*; 128, *Anthidium vigintiduopunctatum*.

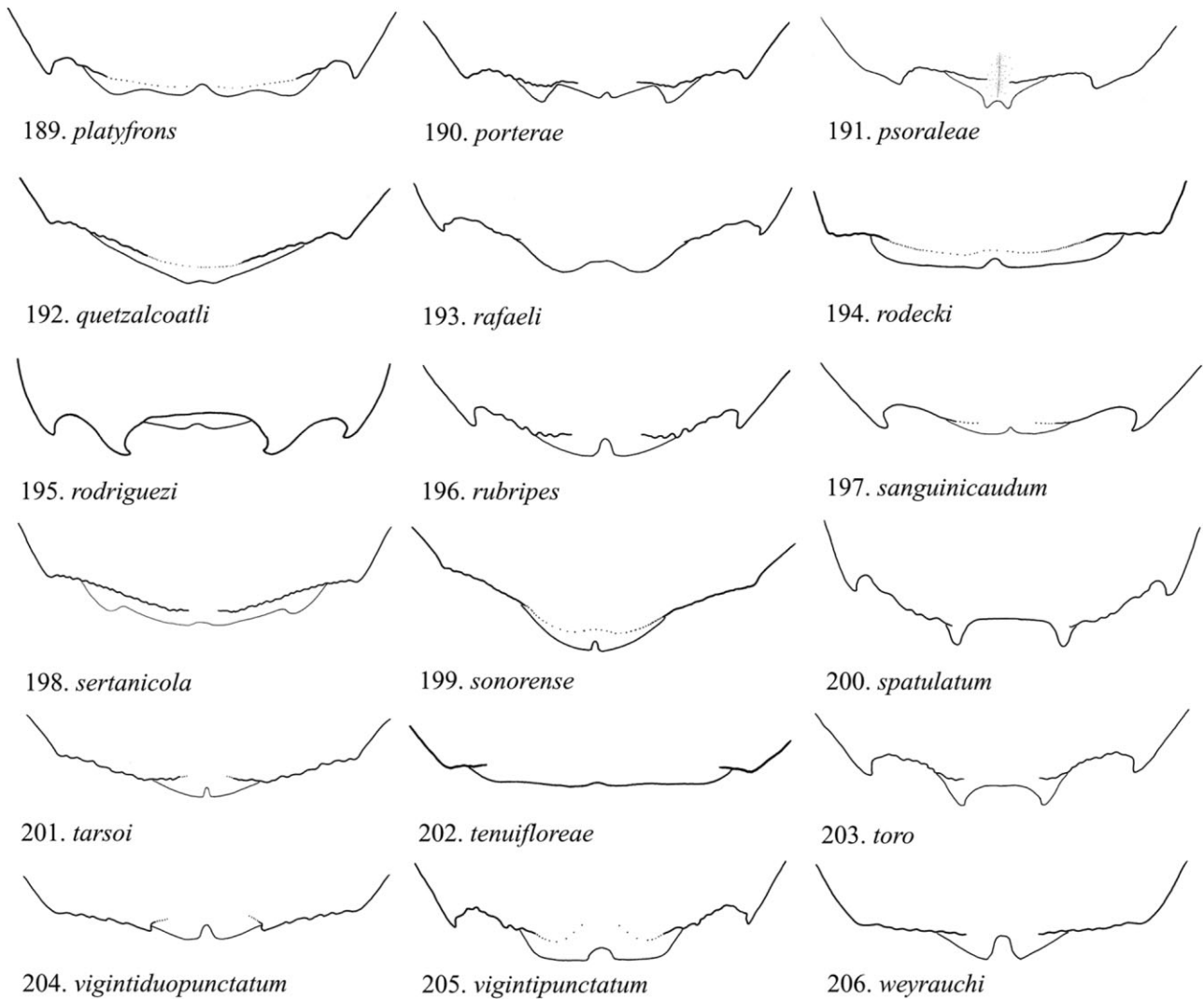




**Figures 129–158.** Contour of distal margin of sixth tergum of *Anthidium* females in dorsal view (pubescence omitted).

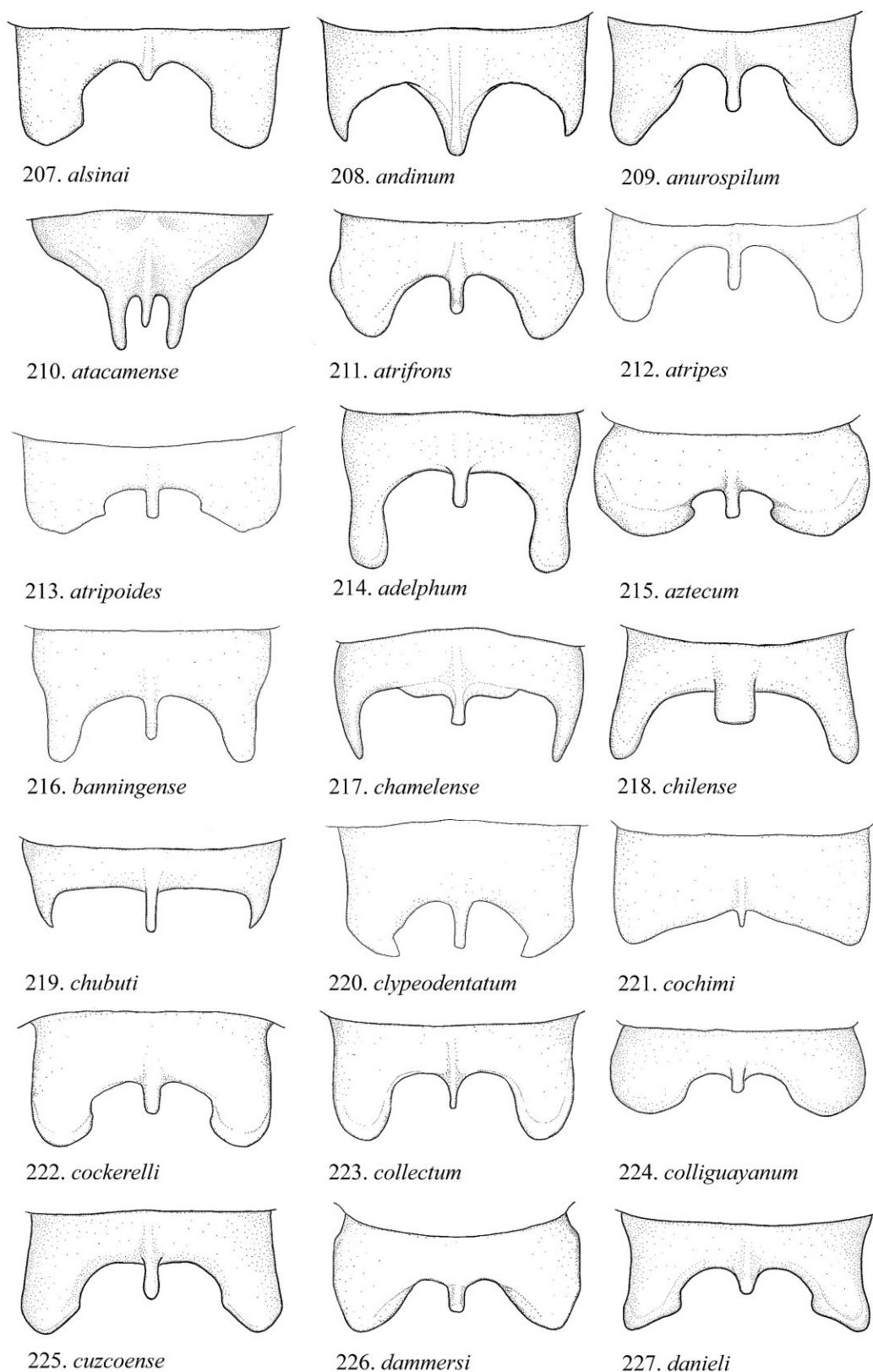


**Figures 159–188.** Contour of distal margin of sixth tergum of *Anthidium* females in dorsal view (pubescence omitted).

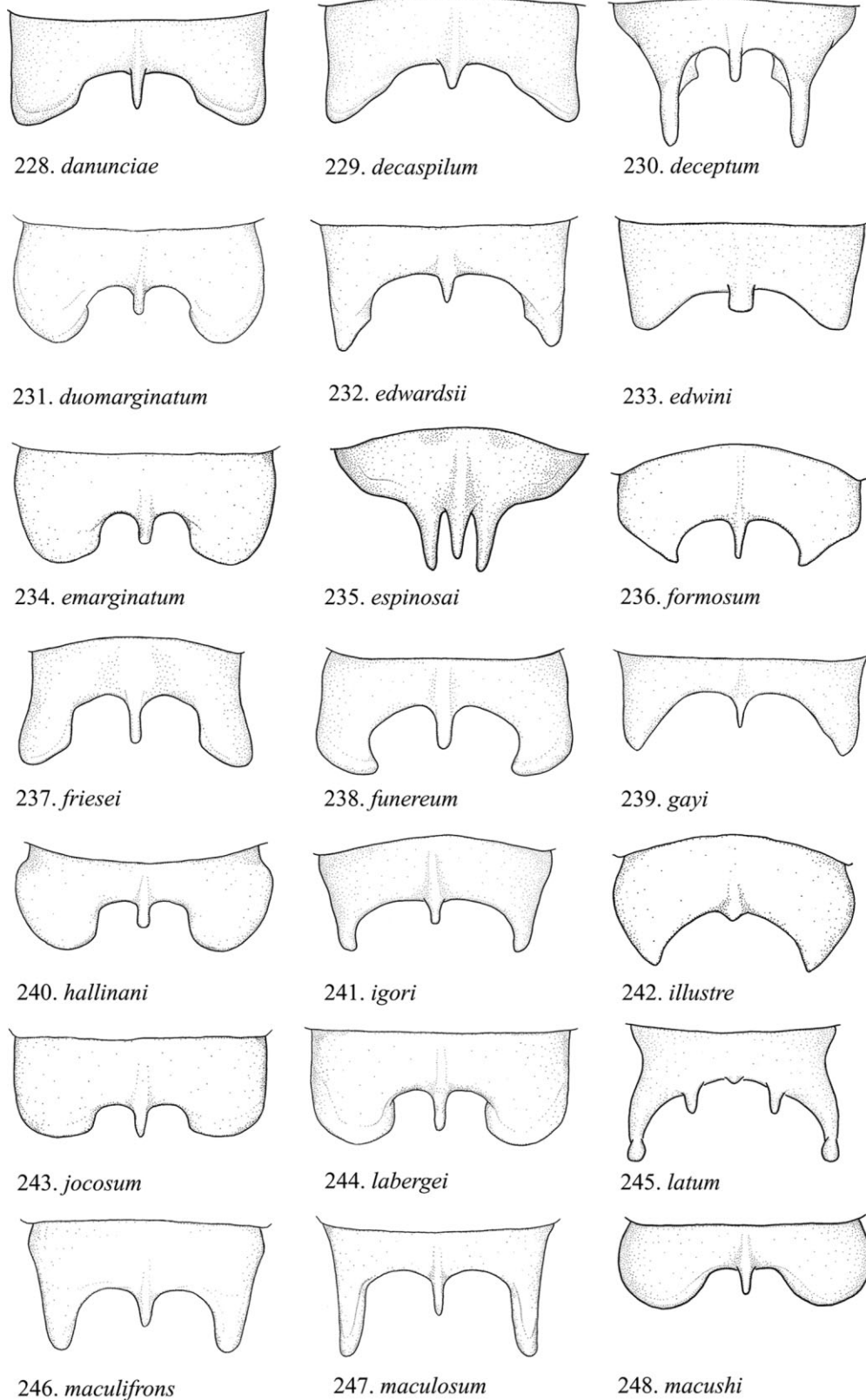


**Figures 189–206.** Contour of distal margin of sixth tergum of *Anthidium* females in dorsal view (pubescence omitted).

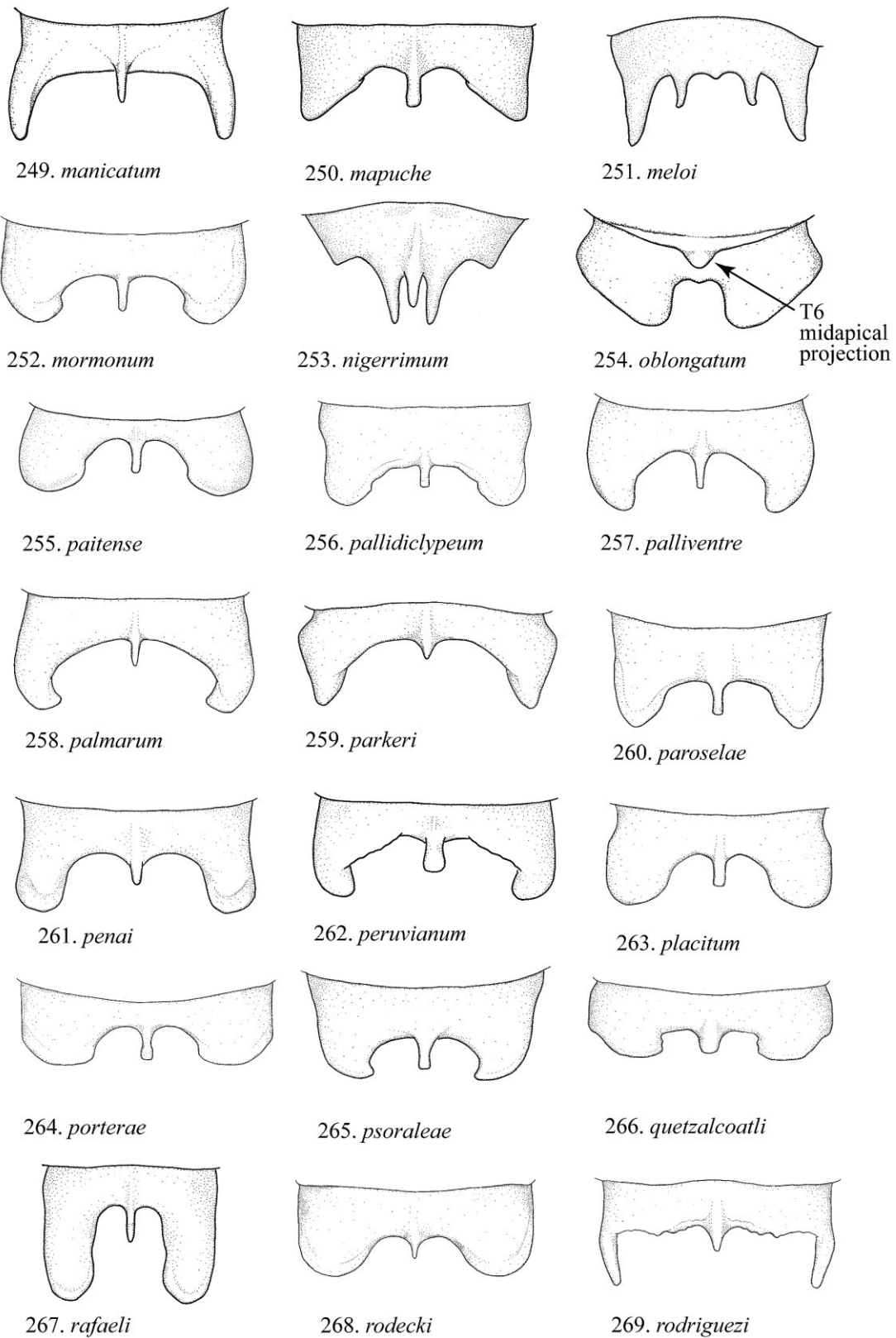




**Figures 207–227.** Dorsal view of seventh tergum of *Anthidium* males (pubescence omitted).

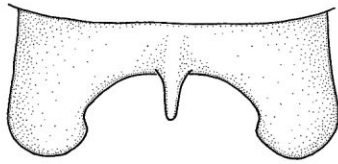
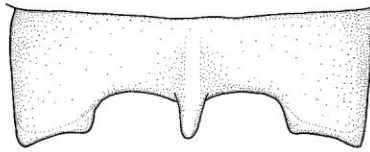
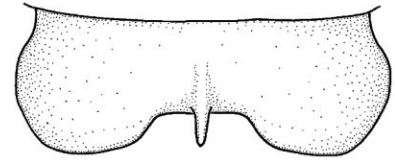
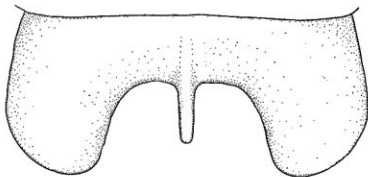
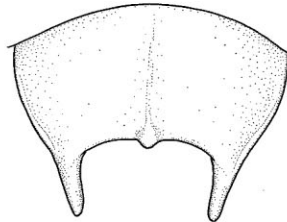
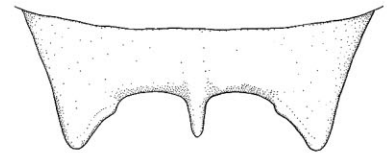
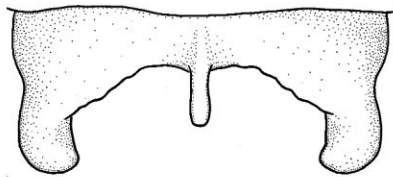
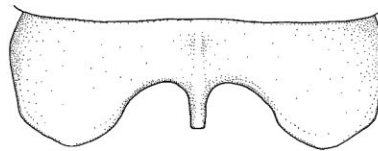
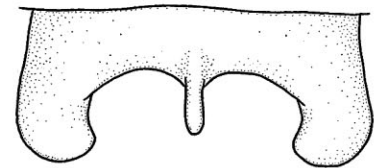
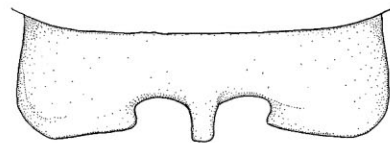
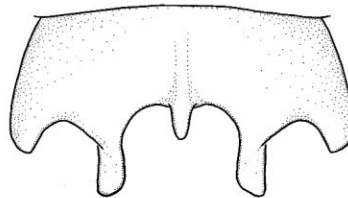
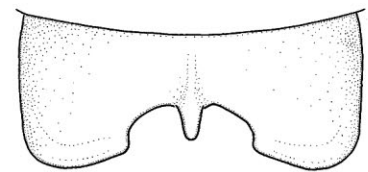
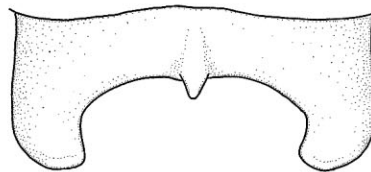


**Figures 228–248.** Dorsal view of seventh tergum of *Anthidium* males (pubescence omitted).

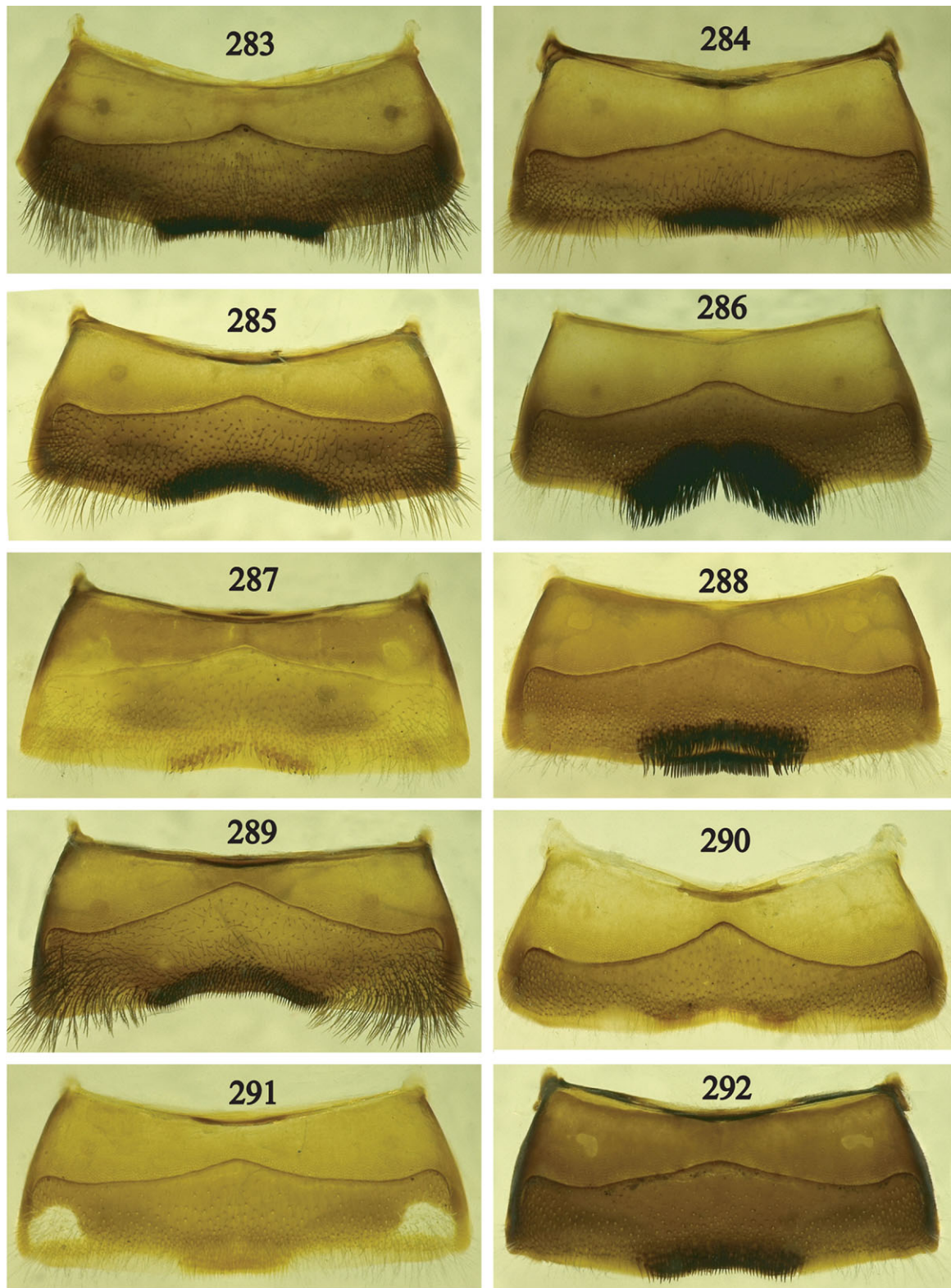


**Figures 249–269.** Dorsal view of seventh tergum of *Anthidium* males (pubescence omitted).



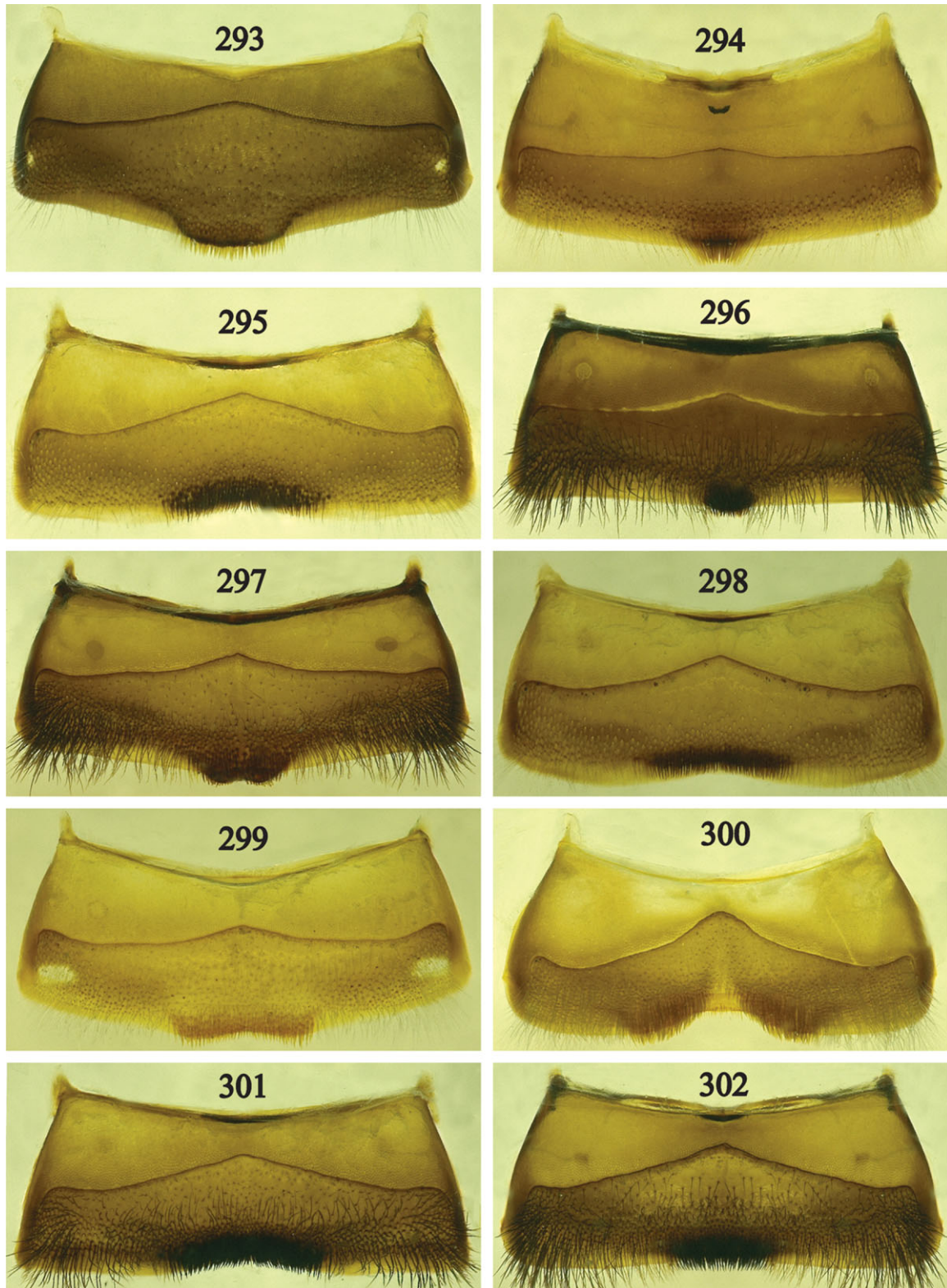
270. *rozeni*271. *rubripes*272. *sanguinicaudum*273. *schwarzi*274. *sertanicola*275. *sonorensis*276. *spatulatum*277. *tenuiflorae*278. *toro*279. *utahense*280. *vigintiduopunctatum*281. *vigintipunctatum*282. *weyrauchi*

**Figures 270–282.** Dorsal view of seventh tergum of *Anthidium* males (pubescence omitted).



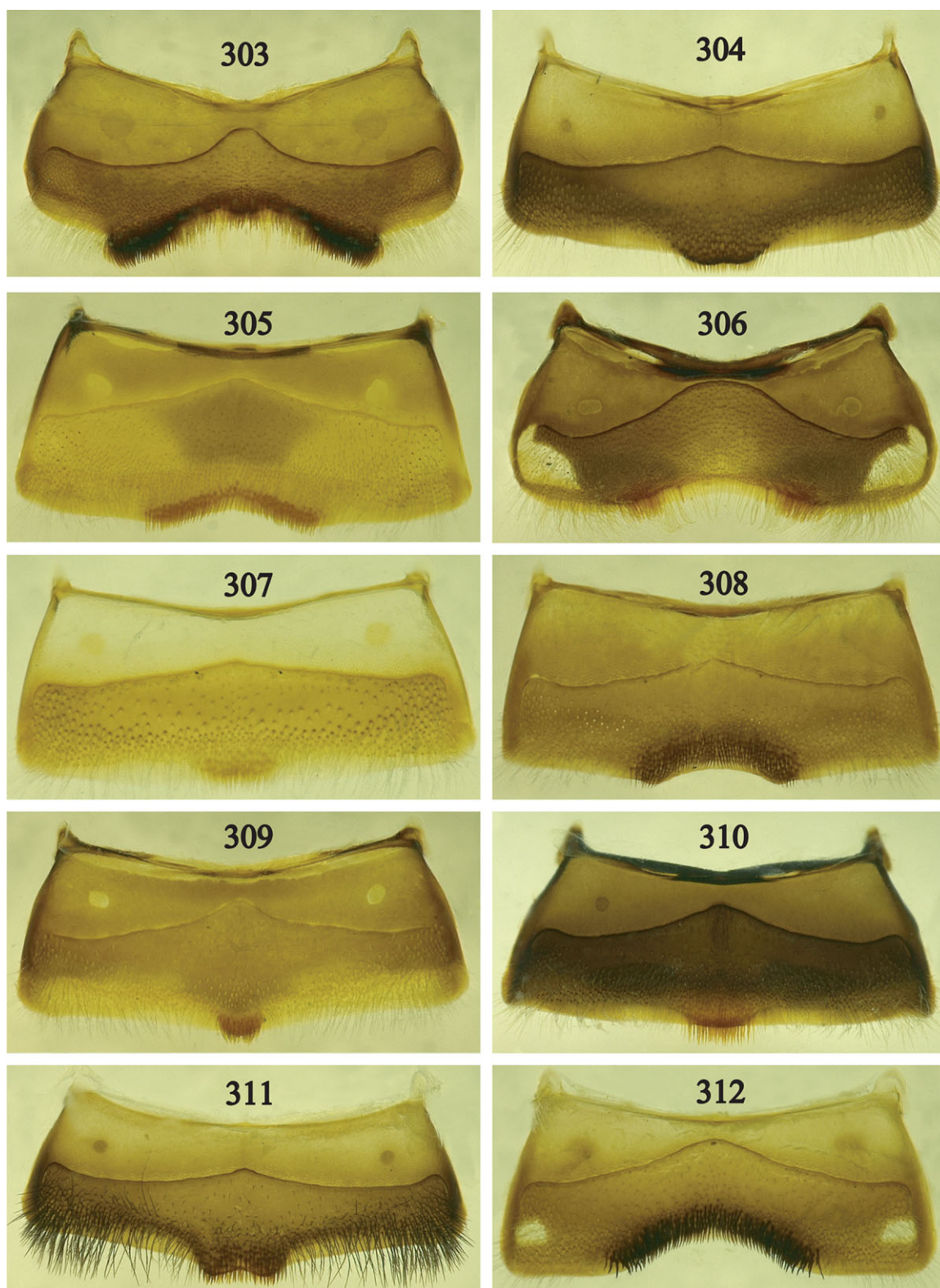
**Figures 283–292.** Ventral view of fourth sternum of *Anthidium* males: 283, *Anthidium anurospilum*; 284, *Anthidium atrifrons*; 285, *Anthidium atripes*; 286, ***Anthidium adelphum* sp. nov.**; 287, *Anthidium aztecum*; 288, *Anthidium banningense*; 289, *Anthidium chubuti*; 290, *Anthidium clypeodentatum*; 291, *Anthidium cockerelli*; 292, *Anthidium collectum*.





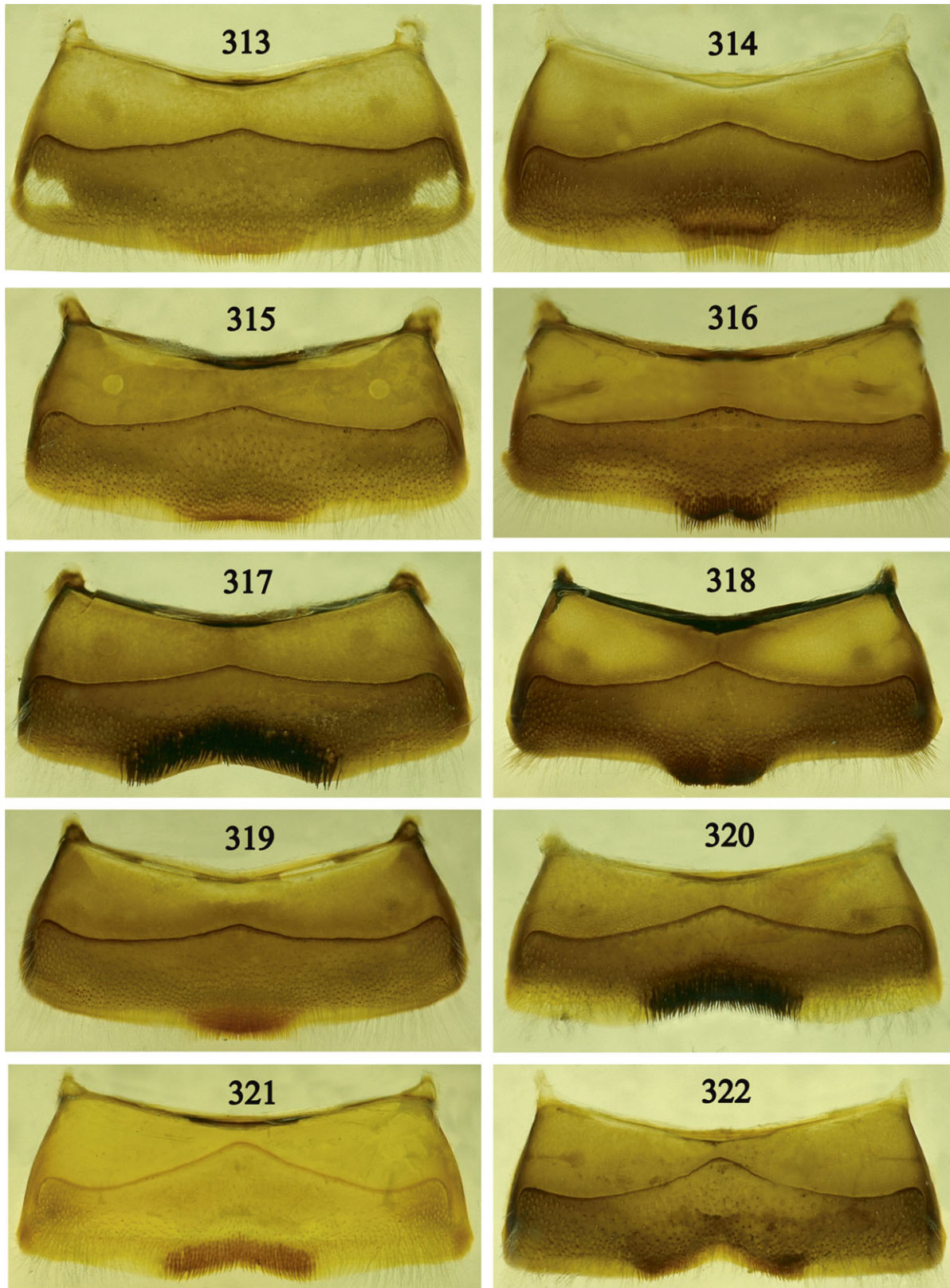
**Figures 293–302.** Ventral view of fourth sternum of *Anthidium* males: 293, *Anthidium colliguayanum*; 294, *Anthidium cuzcoense*; 295, *Anthidium dammersi*; 296, *Anthidium danunciae* sp. nov.; 297, *Anthidium decaspilum*; 298, *Anthidium duomarginatum* sp. nov.; 299, *Anthidium edwardsii*; 300, *Anthidium edwini*; 301, *Anthidium emarginatum*; 302, *Anthidium espinosai*.



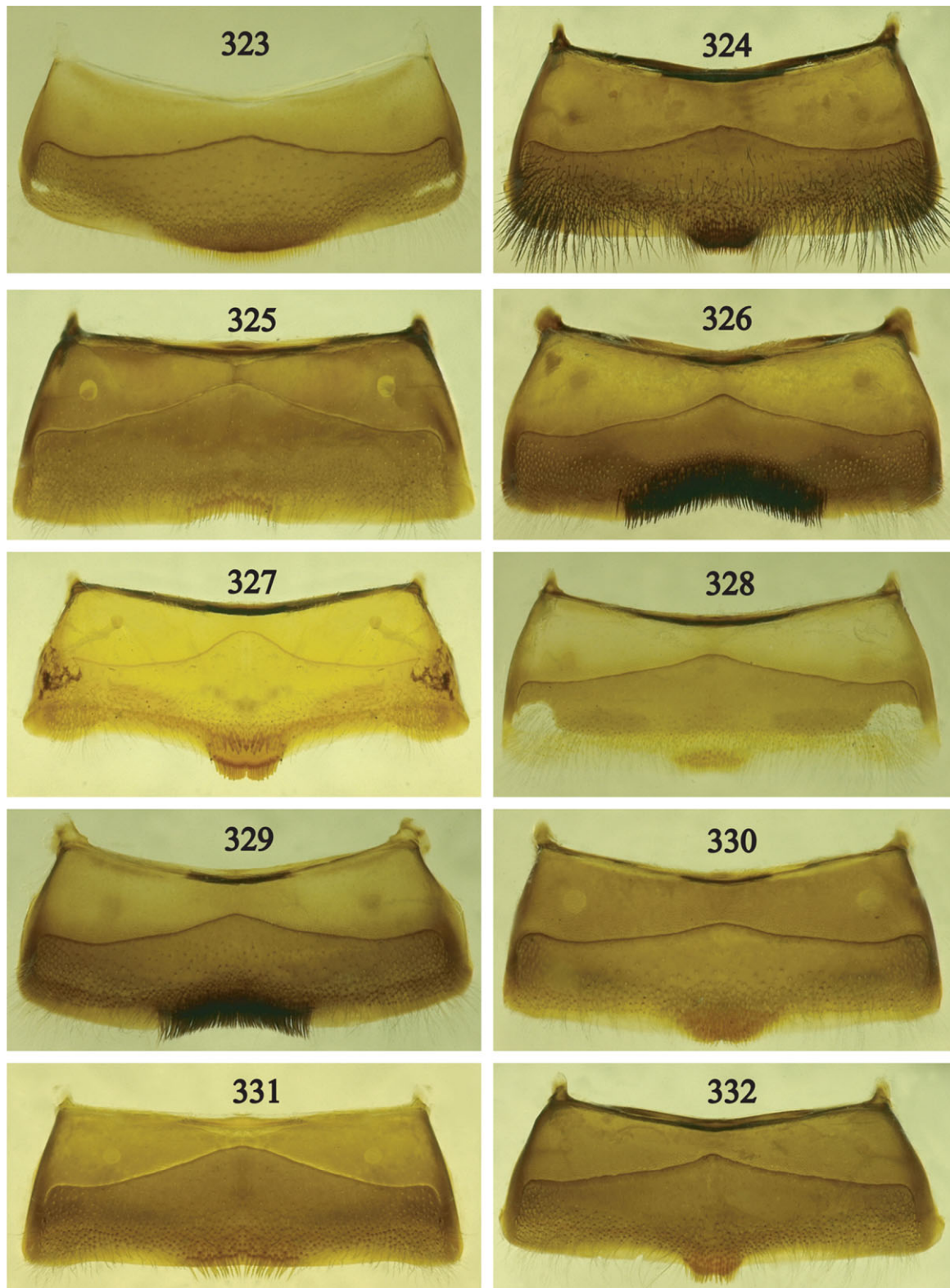


**Figures 303–312.** Ventral view of fourth sternum of *Anthidium* males: 303, *Anthidium formosum*; 304, *Anthidium gayi*; 305, *Anthidium hallinani*; 306, *Anthidium illustre*; 307, *Anthidium jocosum*; 308, *Anthidium labergei* sp. nov.; 309, *Anthidium maculifrons*; 310, *Anthidium manicatum*; 311, *Anthidium mapuche* sp. nov.; 312 *Anthidium michenerorum* sp. nov.



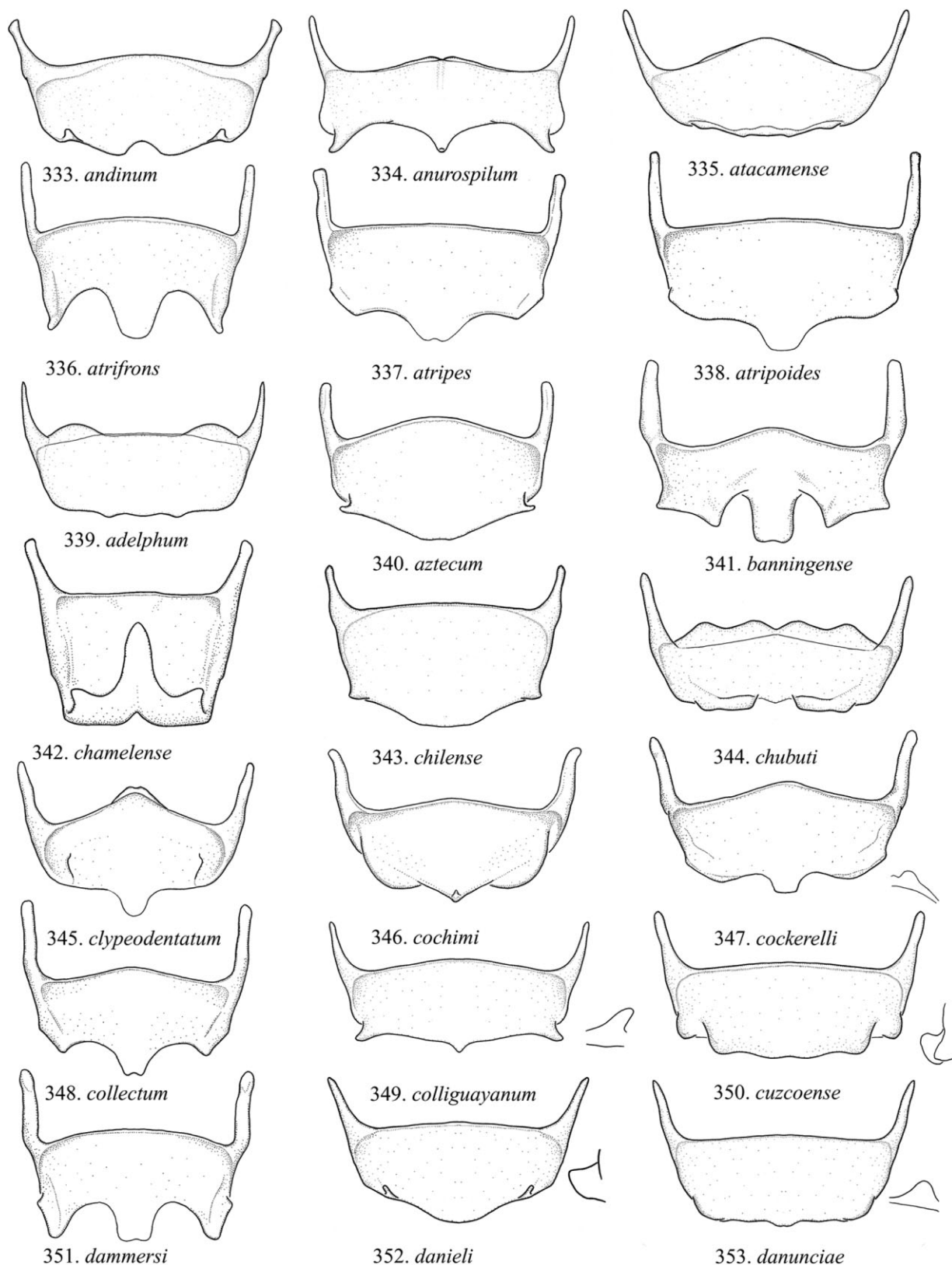


**Figures 313–322.** Ventral view of fourth sternum of *Anthidium* males: 313, *Anthidium mormonum*; 314, *Anthidium paitense*; 315, *Anthidium pallidiclypeum*; 316, *Anthidium palliventris*; 317, *Anthidium palmarum*; 318, *Anthidium penai*; 319, *Anthidium placitum*; 320, ***Anthidium platyfrons* sp. nov.**; 321, *Anthidium porterae*; 322, *Anthidium psoraleae*.

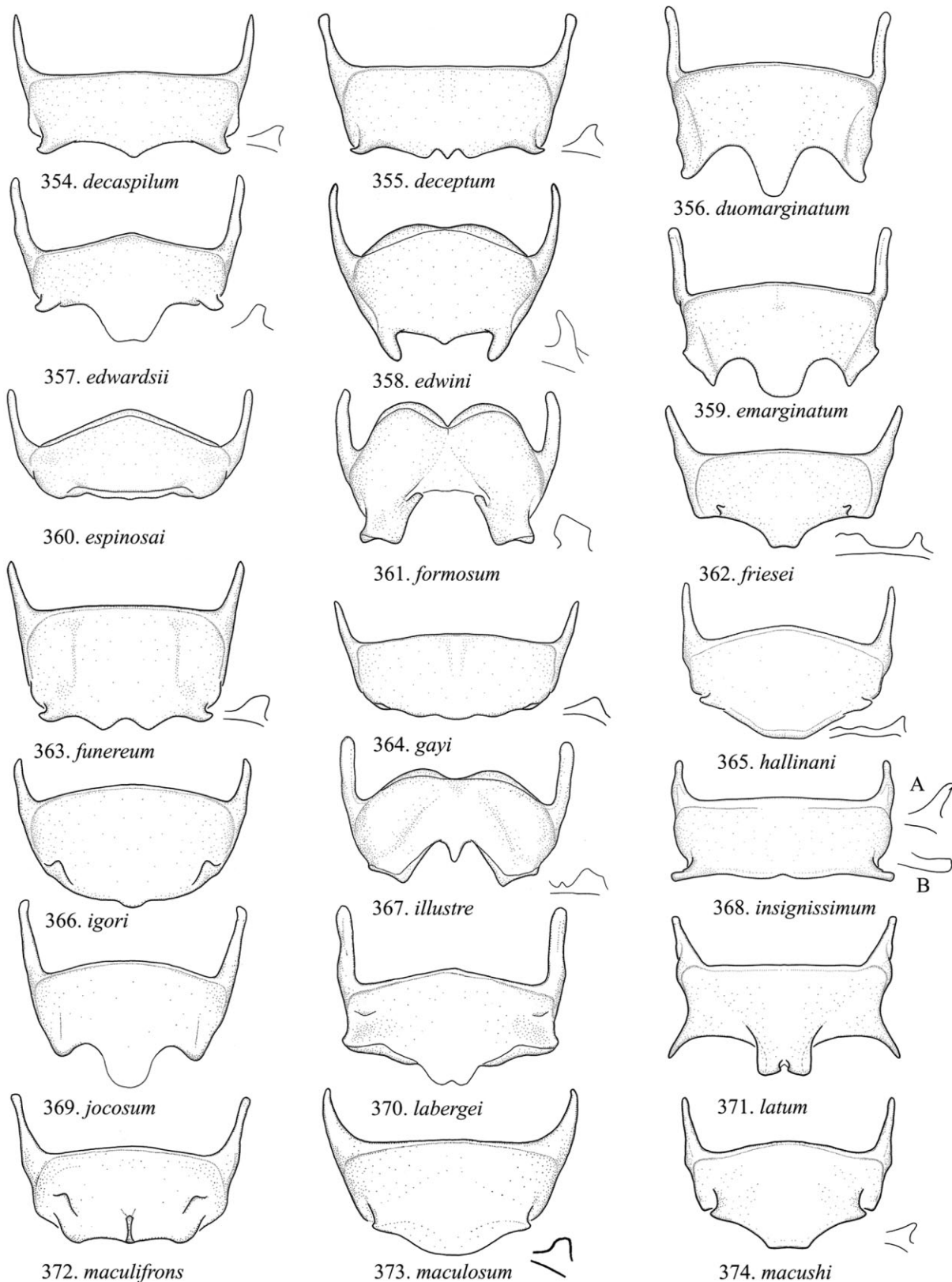


**Figures 323–332.** Ventral view of fourth sternum of *Anthidium* males: 323, *Anthidium rodecki*; 324, *Anthidium rubripes*; 325, *Anthidium sanguinicaudum*; 326, ***Anthidium schwarzi* sp. nov.**; 327, *Anthidium sertanicola*; 328, *Anthidium sonorensis*; 329, *Anthidium tenuiflorae*; 330, *Anthidium utahense*; 331, *Anthidium vigintiduopunctatum*; 332, *Anthidium vigintipunctatum*.

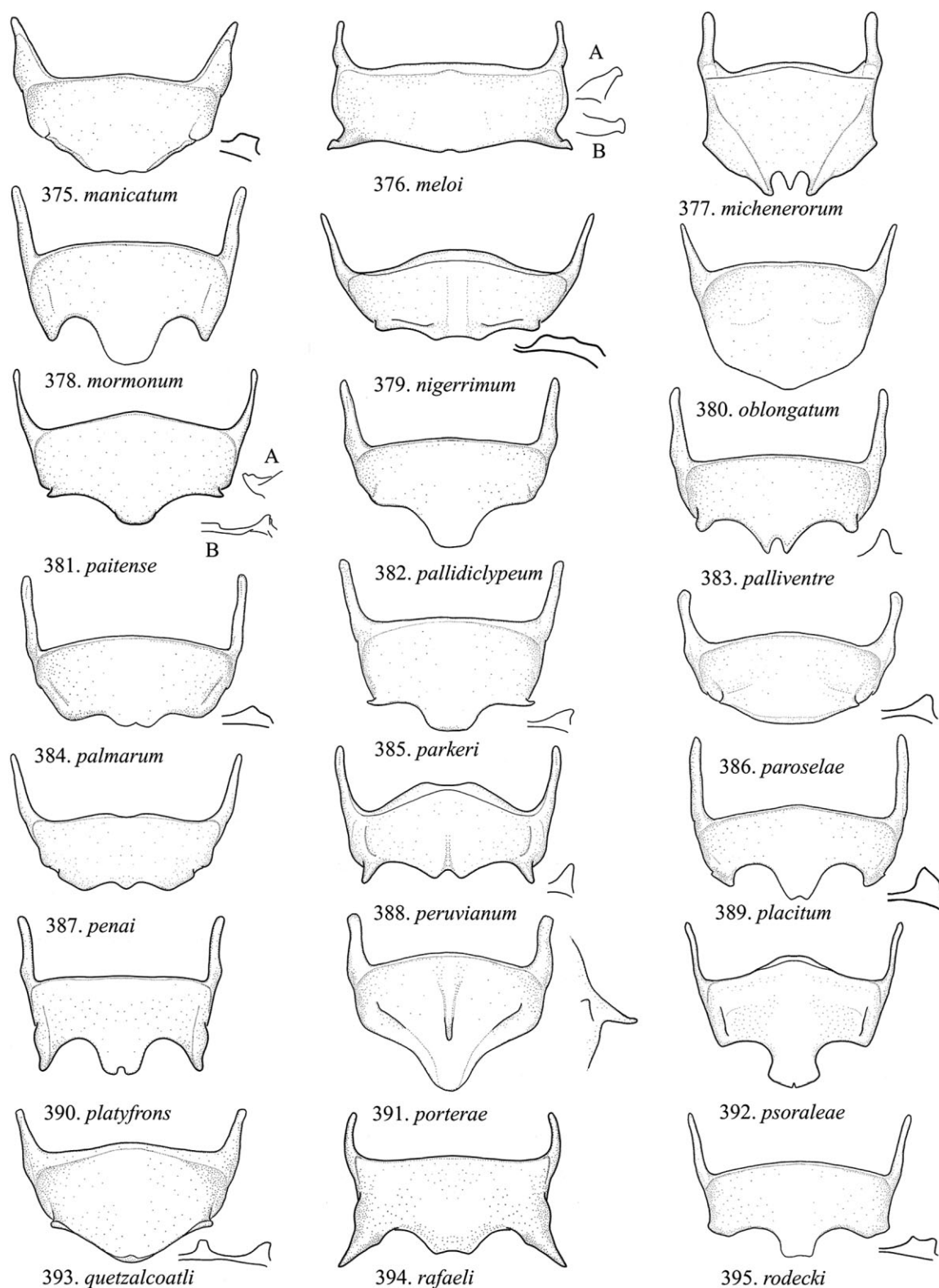




**Figures 333–353.** Ventral view of sixth sternum of *Anthidium* males (pubescence omitted). A posterior view of the lateral spine or angle is shown next to the lower right portion of some figures (347, 349, 353); 350 and 352 are in profile view.

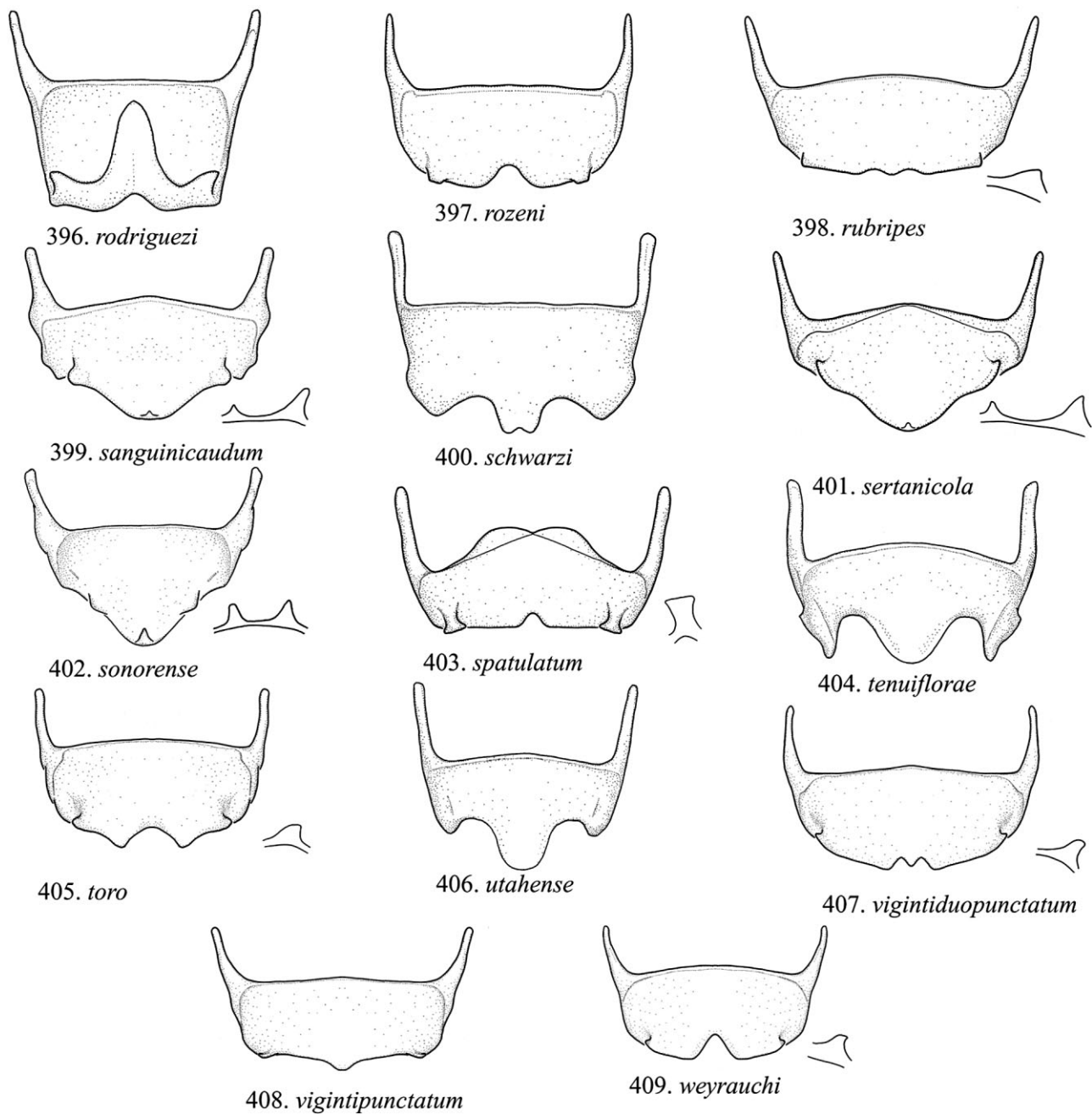


**Figures 354–374.** Ventral view of sixth sternum of *Anthidium* males (pubescence omitted). A posterior view of the lateral spine or angle is shown next to the lower right portion of some figures; 362, 365, and 367 also show the midapical margin, and 368 shows the lateral spine in posterior (A) and ventrolateral (B) views.

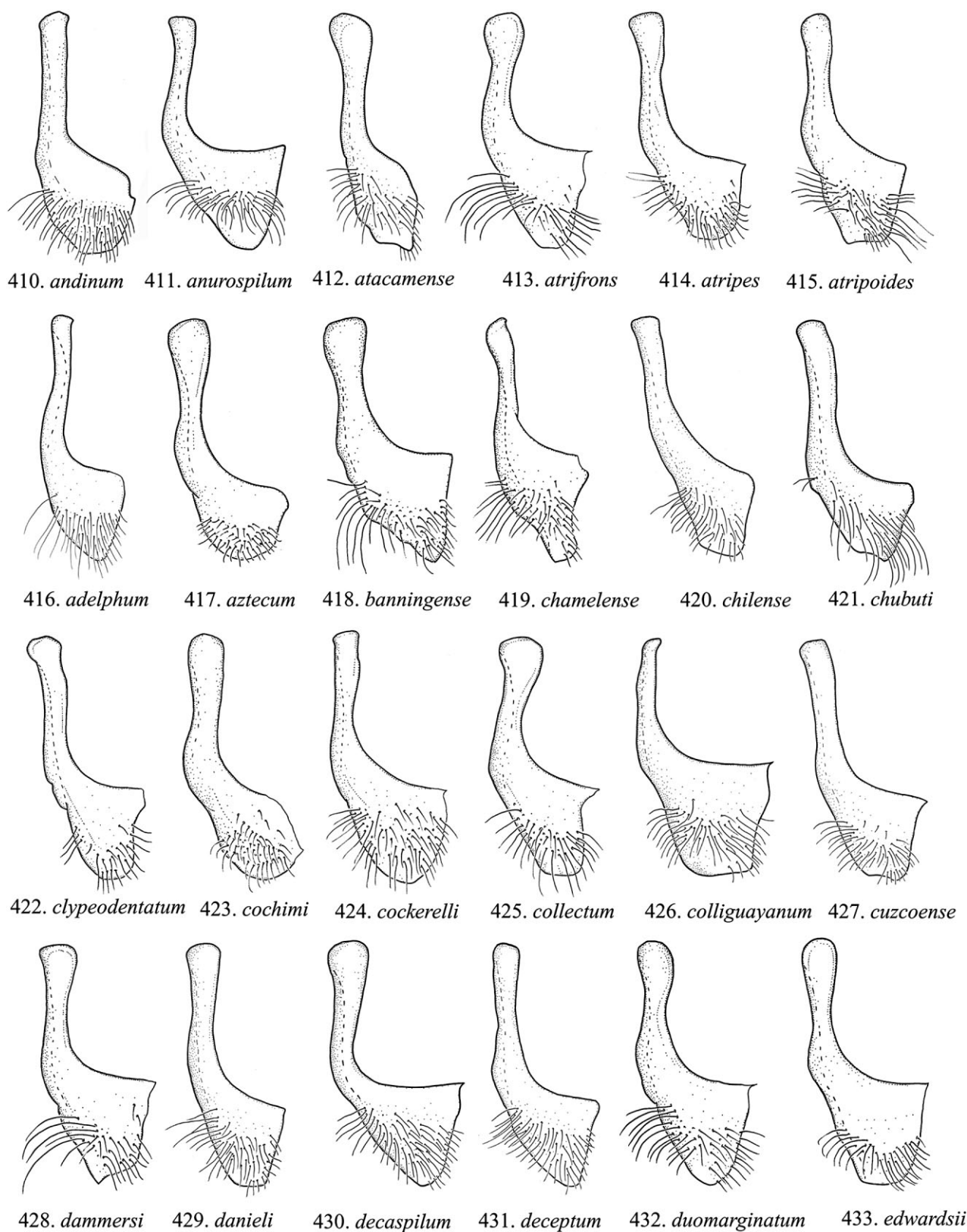


**Figures 375–395.** Ventral view of sixth sternum of *Anthidium* males (pubescence omitted). A posterior view of the lateral spine or angle is shown next to the lower right portion of some figures, except for: 376 shows the lateral spine in posterior (A) and ventrolateral (B) views; 381 shows the lateral spine in profile (A) and in posterior (B) view, including the midapical margin; 391 shows a profile view of the projecting discal carina; 393 shows a posterior view, including the midapical margin.

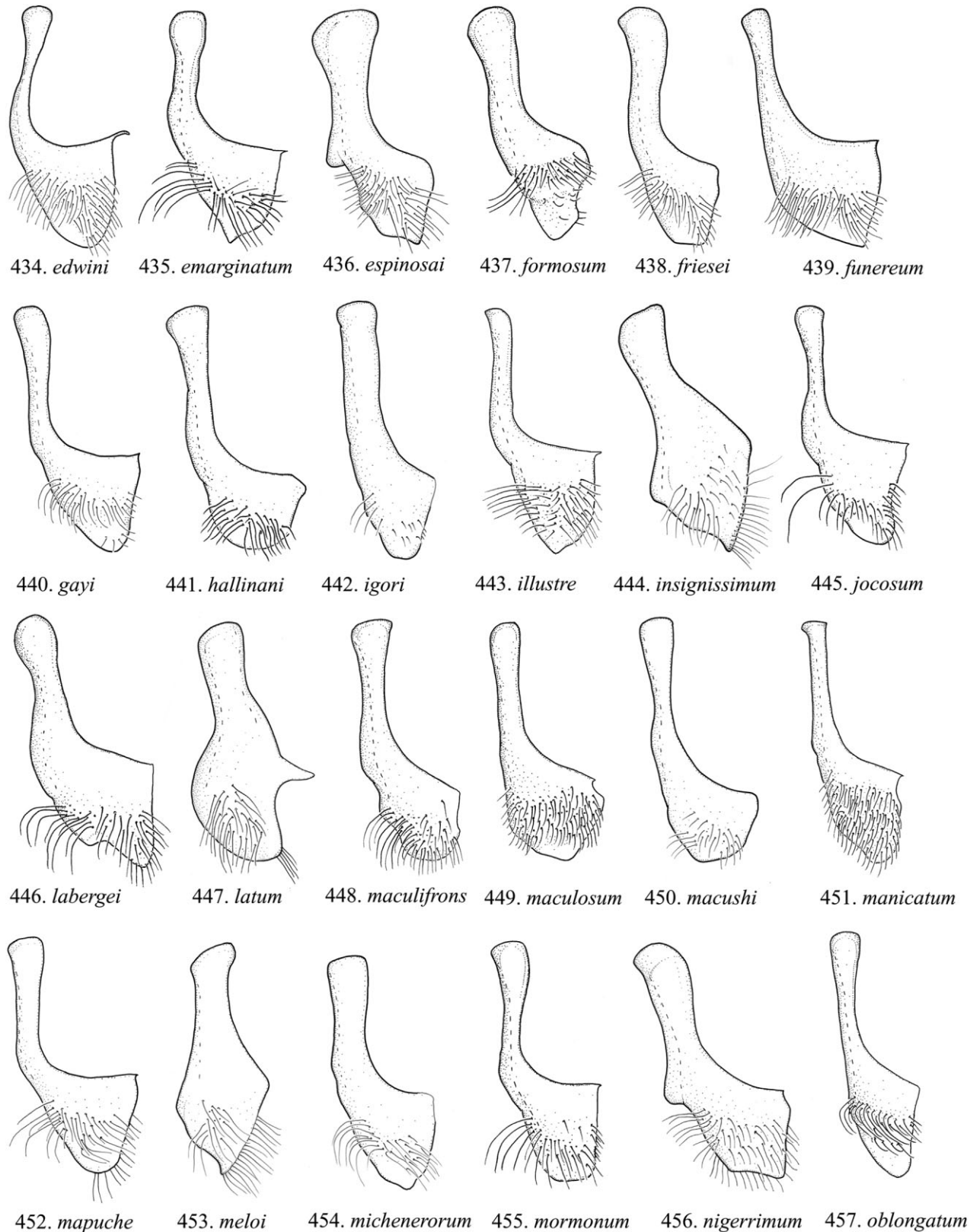




**Figures 396–409.** Ventral view of sixth sternum of *Anthidium* males (pubescence omitted). A posterior view of the lateral spine or angle is shown next to the lower right portion of some figures, except for 399, 401, and 402, which also show the midapical margin.

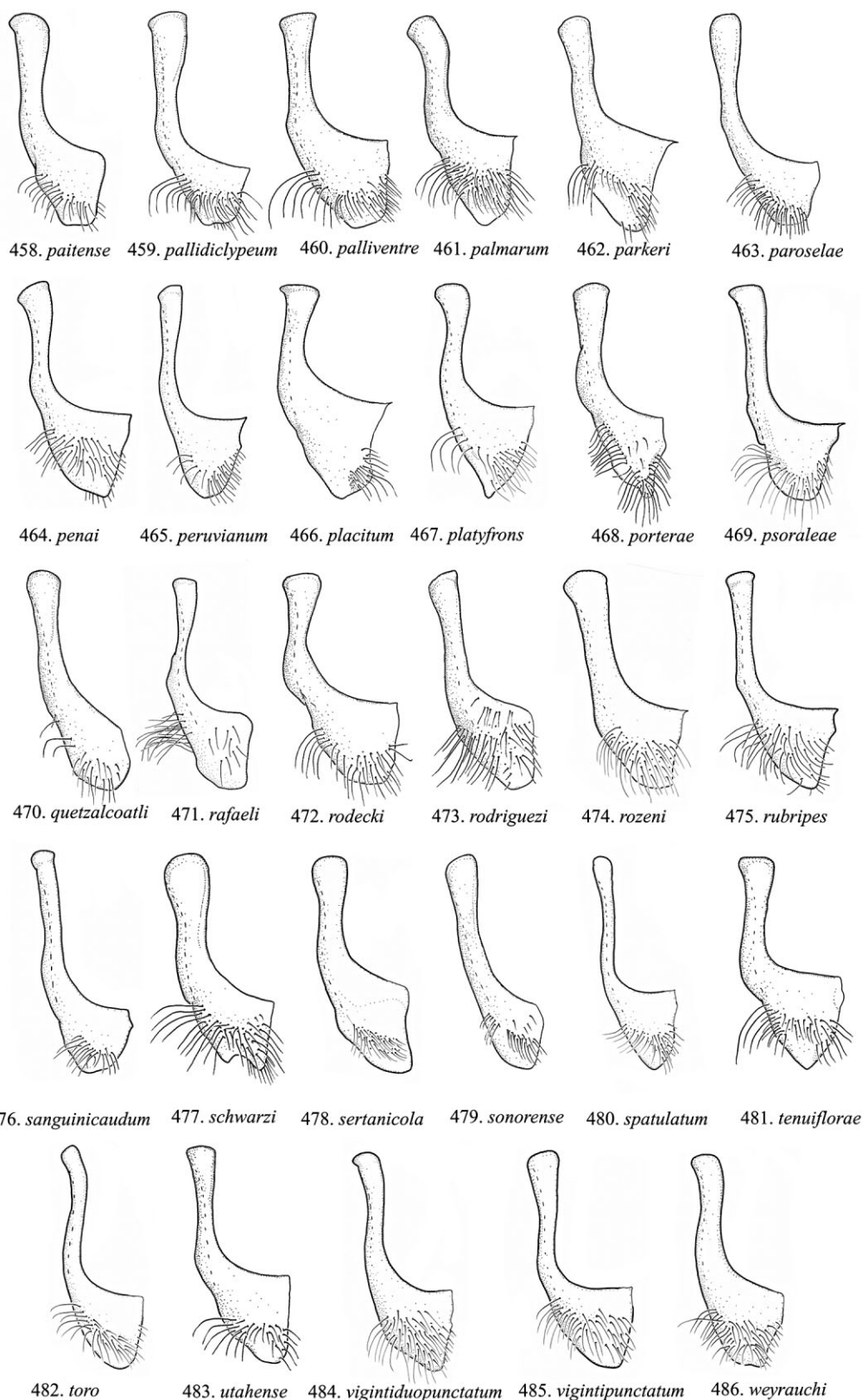


**Figures 410–433.** Ventral view of seventh hemisternite of *Anthidium* males; the minutely branched hairs are much longer than shown in the figures.

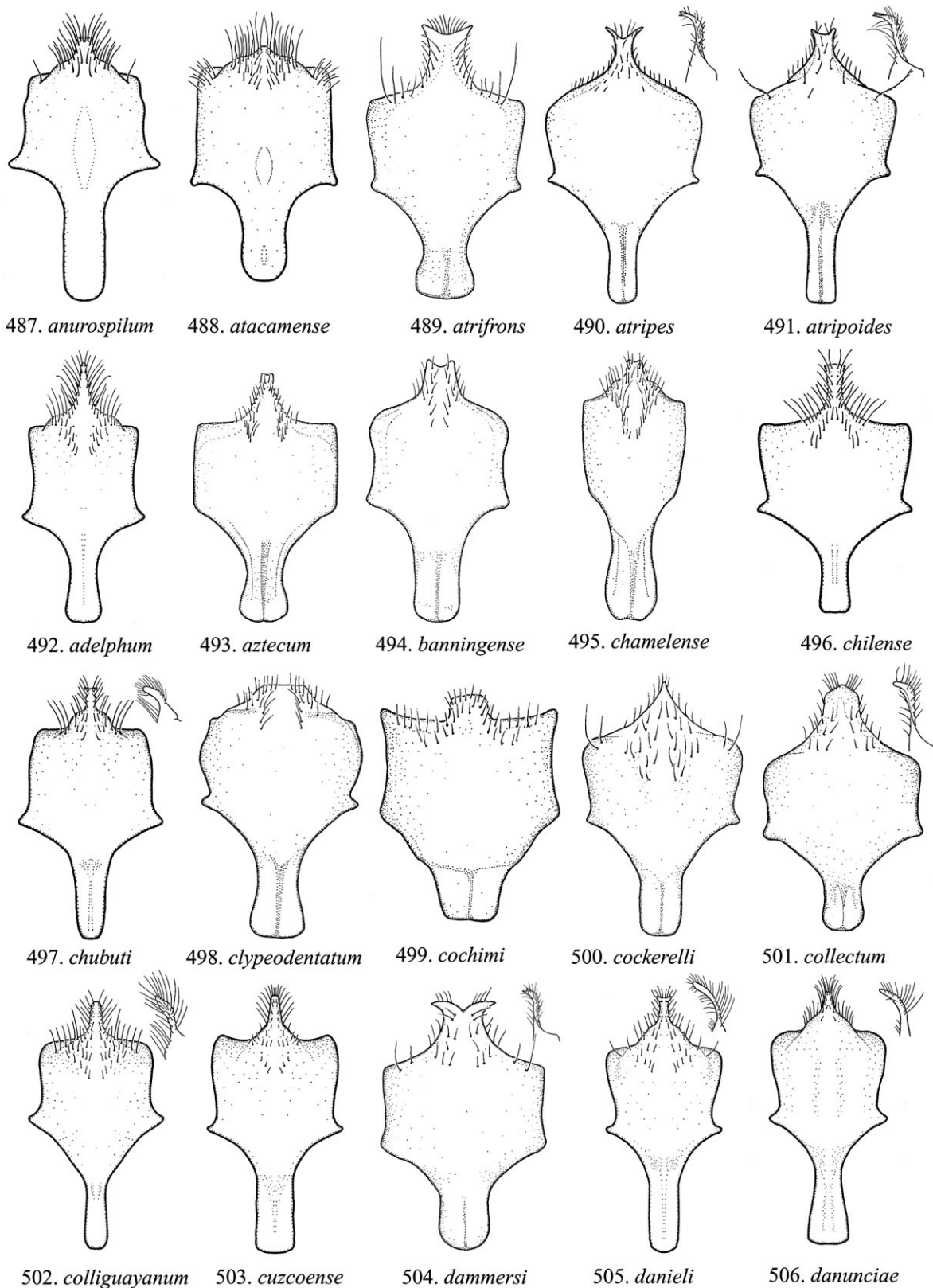


**Figures 434–457.** Ventral view of seventh hemisternite of *Anthidium* males; the minutely branched hairs are much longer than shown in the figures.

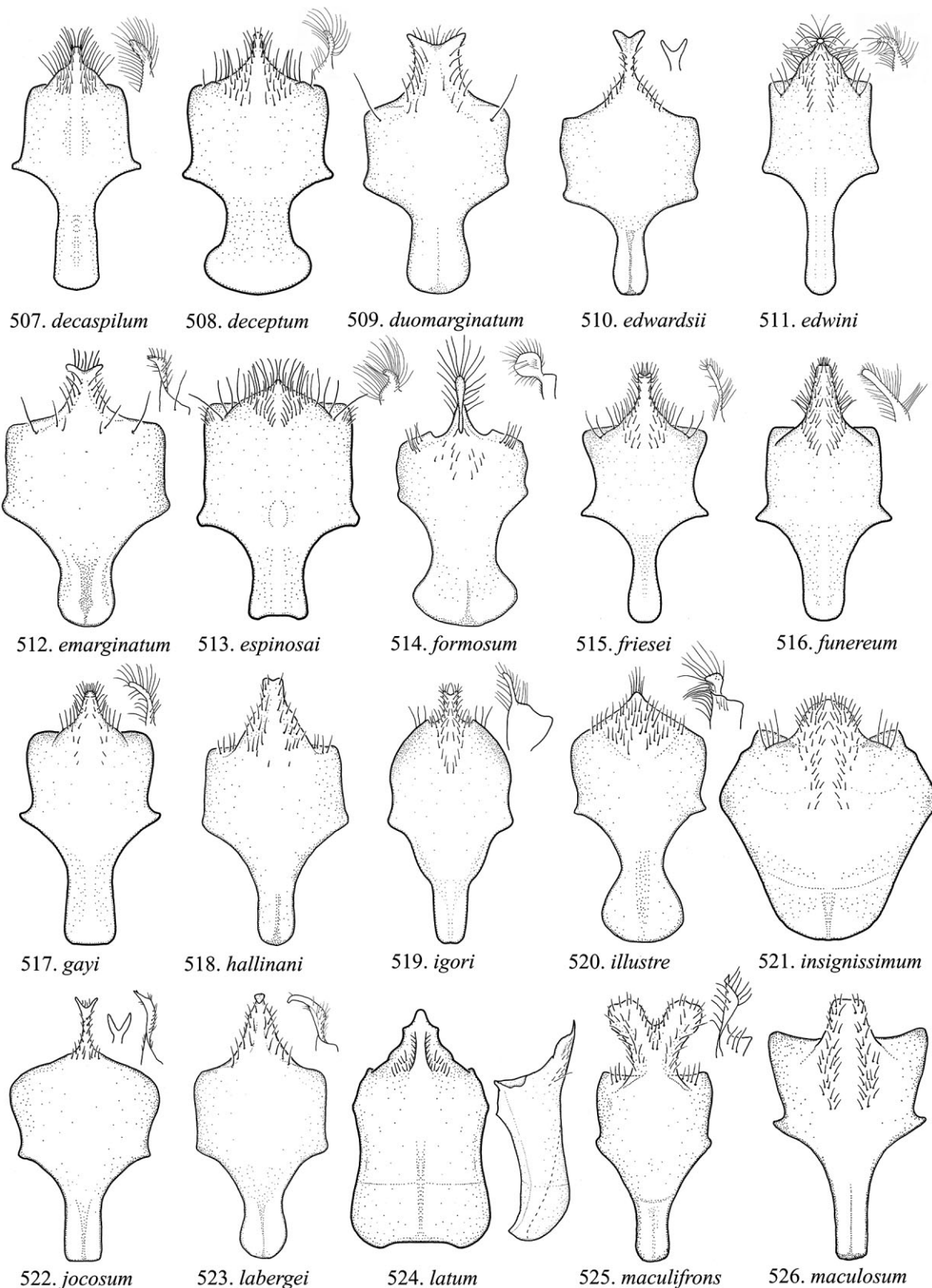




**Figures 458–486.** Ventral view of seventh hemisternite of *Anthidium* males; the minutely branched hairs are much longer than shown in the figures.

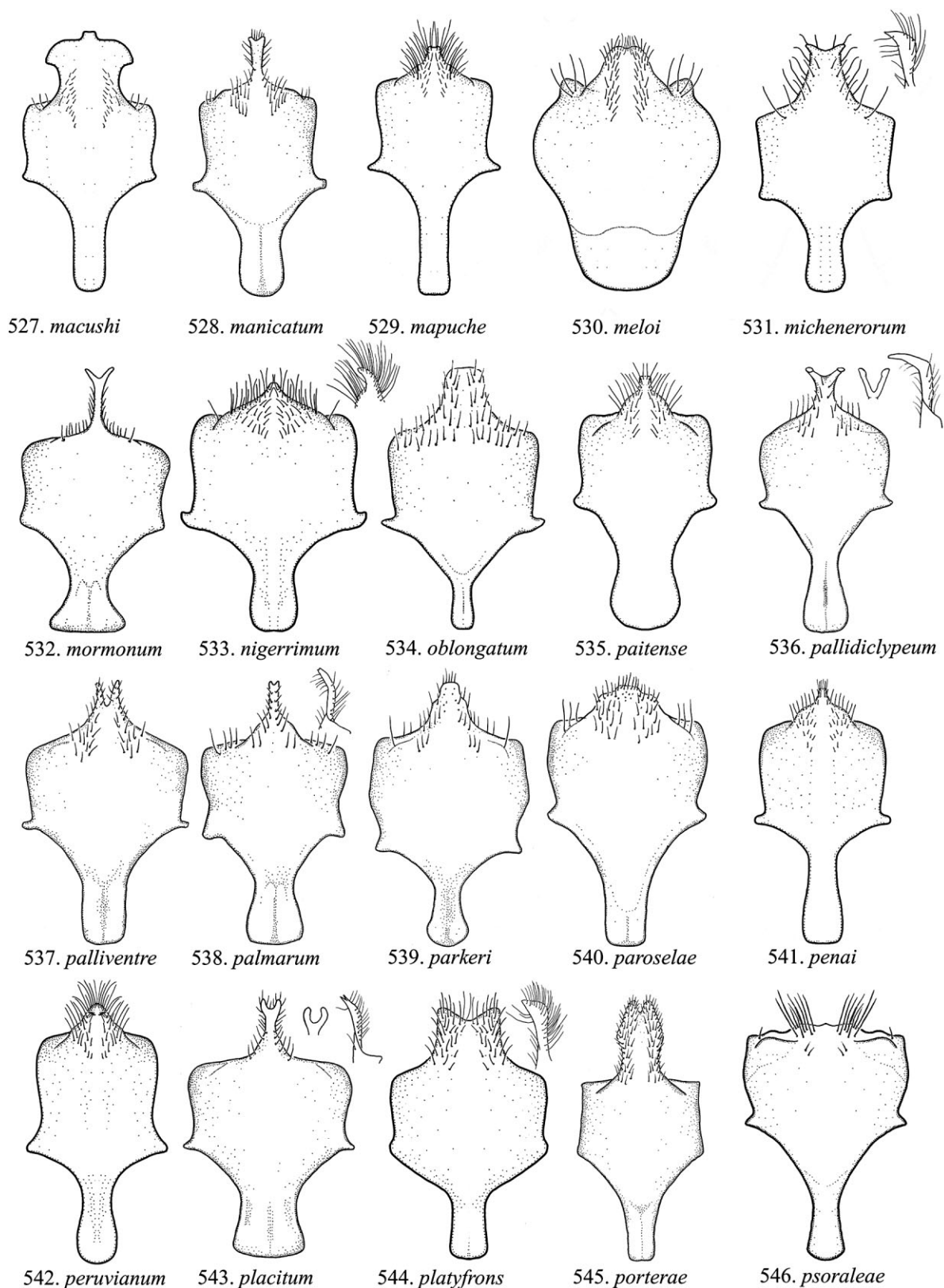


**Figures 487–506.** Ventral view of eighth sternum of *Anthidium* males; the minutely branched hairs are much longer than shown in the figures. A profile view of the apex is shown next to the upper right portion of some figures.

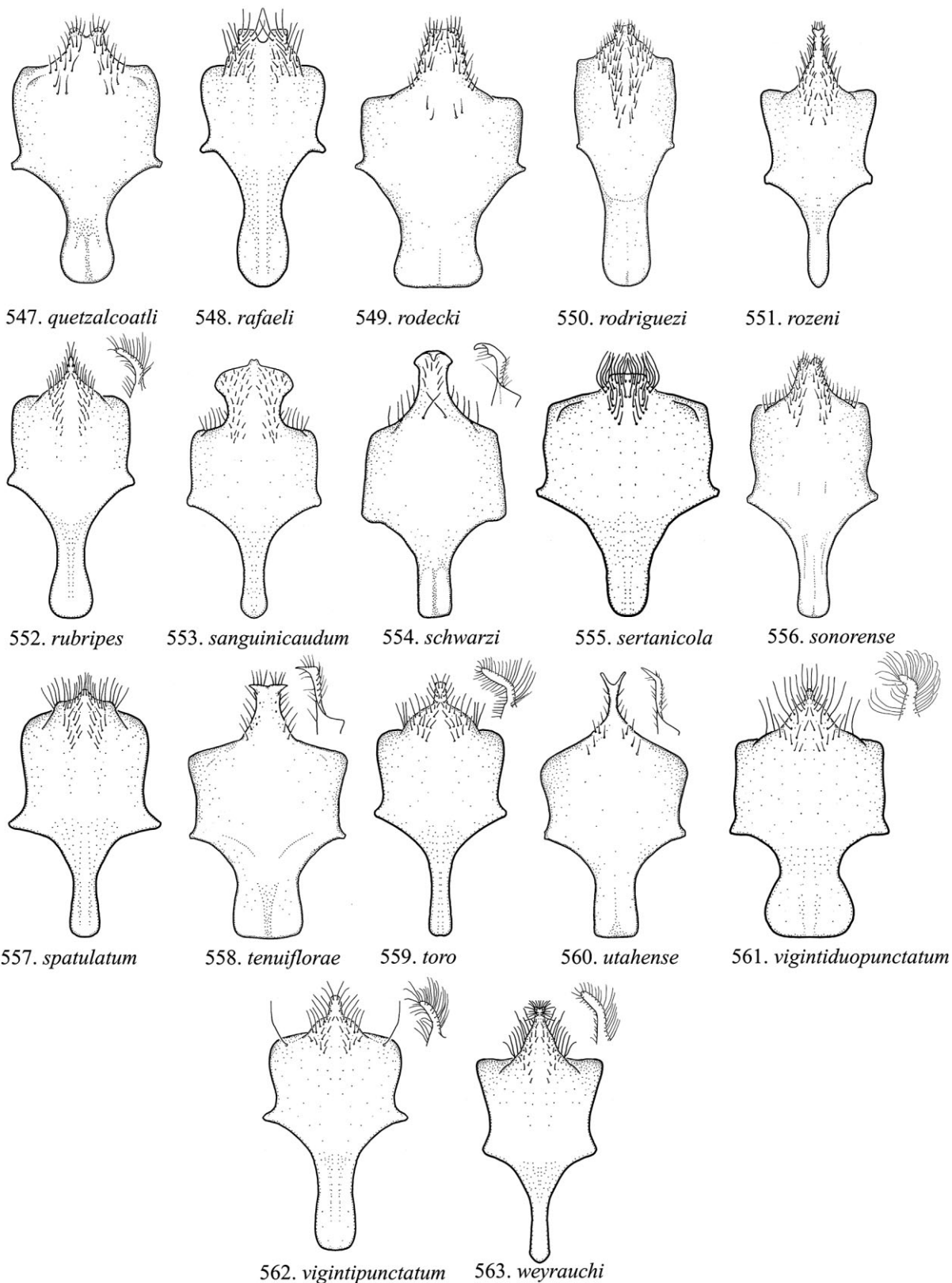


**Figures 507–526.** Ventral view of eighth sternum of *Anthidium* males; the minutely branched hairs are much longer than shown in the figures. A profile view of the apex is shown next to the upper right portion of some figures; 510 shows only a posterior view, 522 shows both a profile and posterior view, and 524 shows a profile of the sternum.



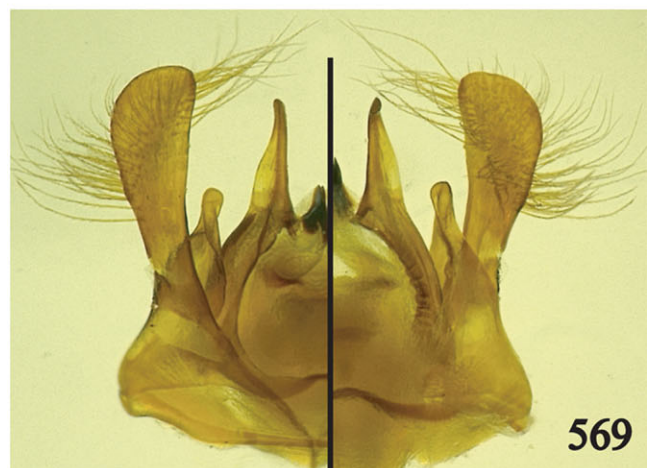
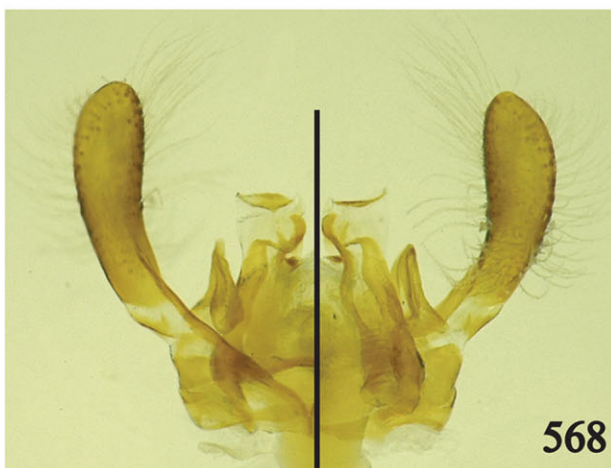
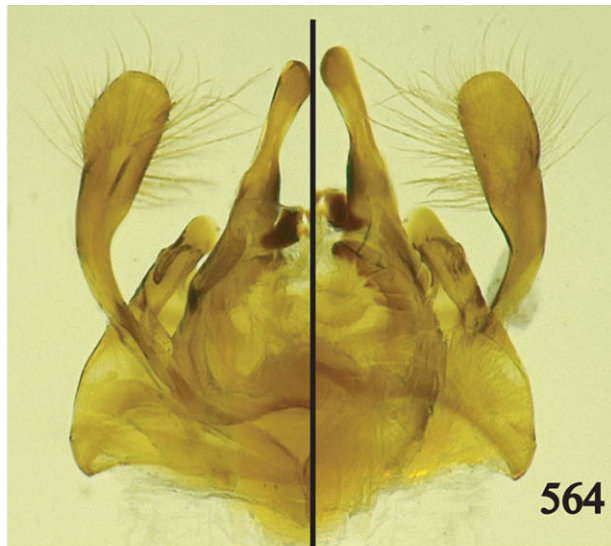


**Figures 527–546.** Ventral view of eighth sternum of *Anthidium* males; the minutely branched hairs are much longer than shown in the figures. A profile view of the apex is shown next to the upper right portion of some figures; a posterior view is also included in 536 and 543.



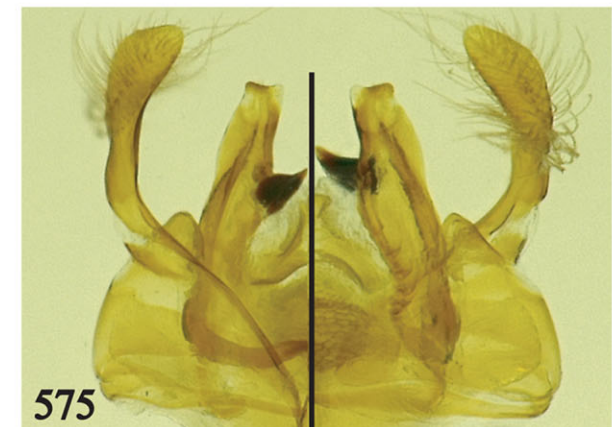
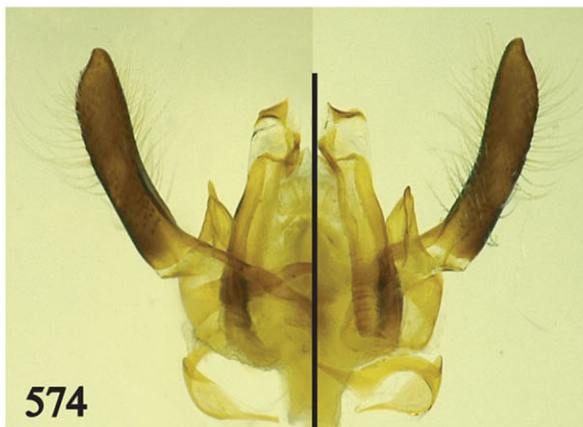
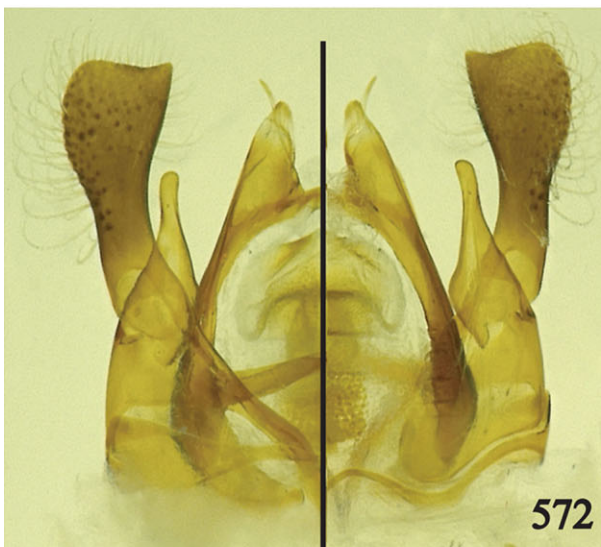
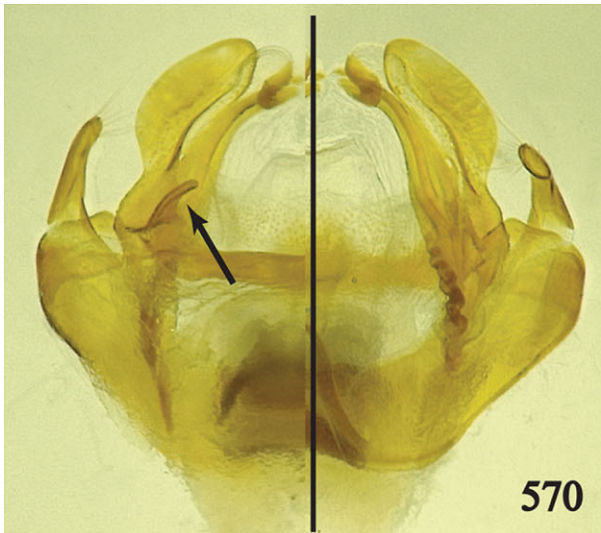
**Figures 547–563.** Ventral view of eighth sternum of *Anthidium* males; the minutely branched hairs are much longer than shown in the figures. A profile view of the apex is shown next to the upper right portion of some figures.



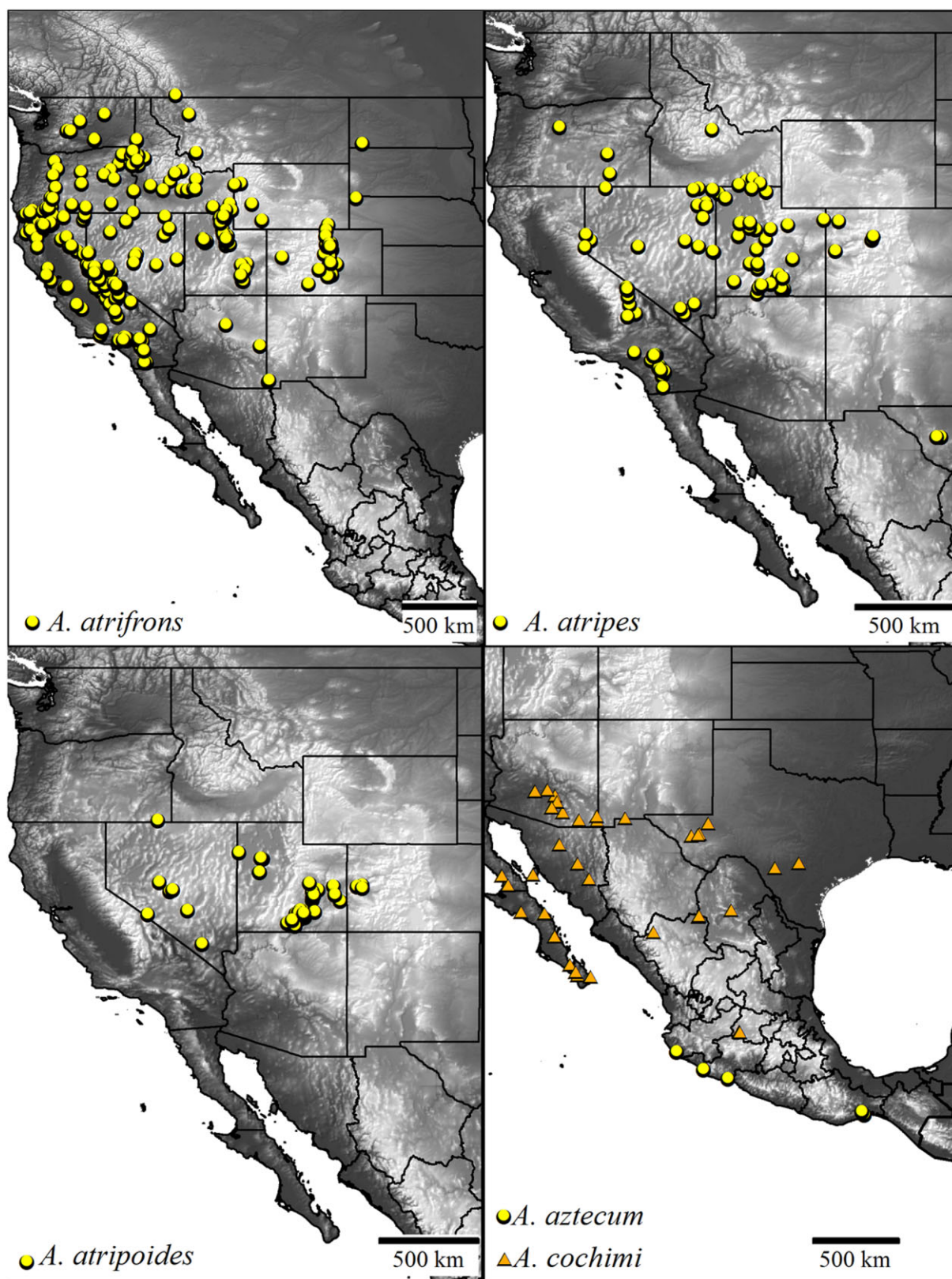


**Figures 564–569.** Genital capsule of *Anthidium* males in dorsal (left half) and ventral (right half) views: 564, *Anthidium atacamense* sp. nov.; 565, *Anthidium chamelense* sp. nov.; 566, *Anthidium danunciae* sp. nov.; 567, *Anthidium duomarginatum* sp. nov.; 568, *Anthidium labergei* sp. nov.; 569, *Anthidium mapuche* sp. nov.



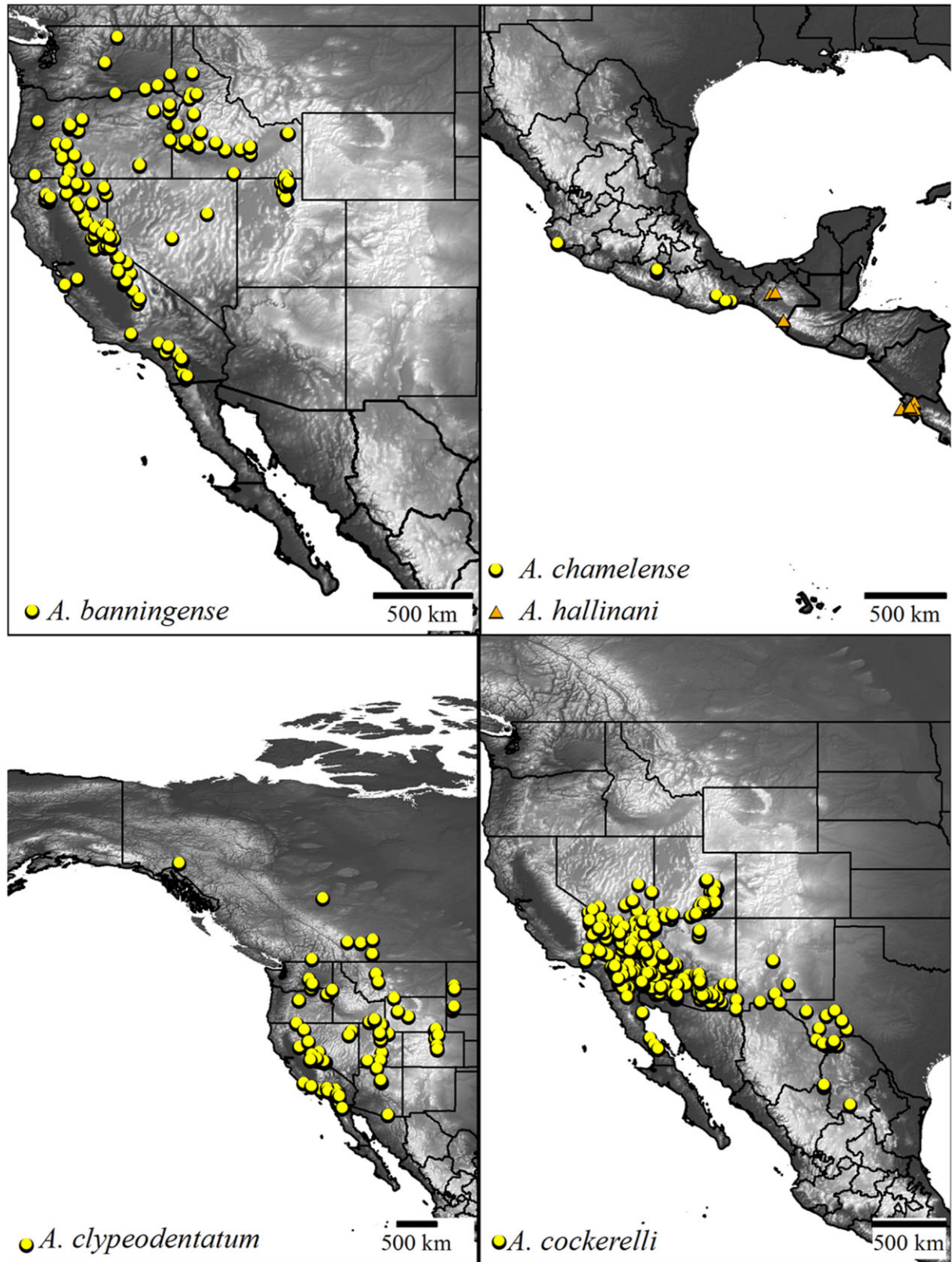


**Figures 570–575.** Genital capsule of *Anthidium* males in dorsal (left half) and ventral (right half) views: 570, *Anthidium meloi* sp. nov., arrow points to hooked lateral projection of the penis valve bridge; 571, *Anthidium michenerorum* sp. nov.; 572, *Anthidium parkeri* sp. nov.; 573, *Anthidium platyfrons* sp. nov.; 574, *Anthidium schwarzi* sp. nov.; 575, *Anthidium spatulatum* sp. nov.



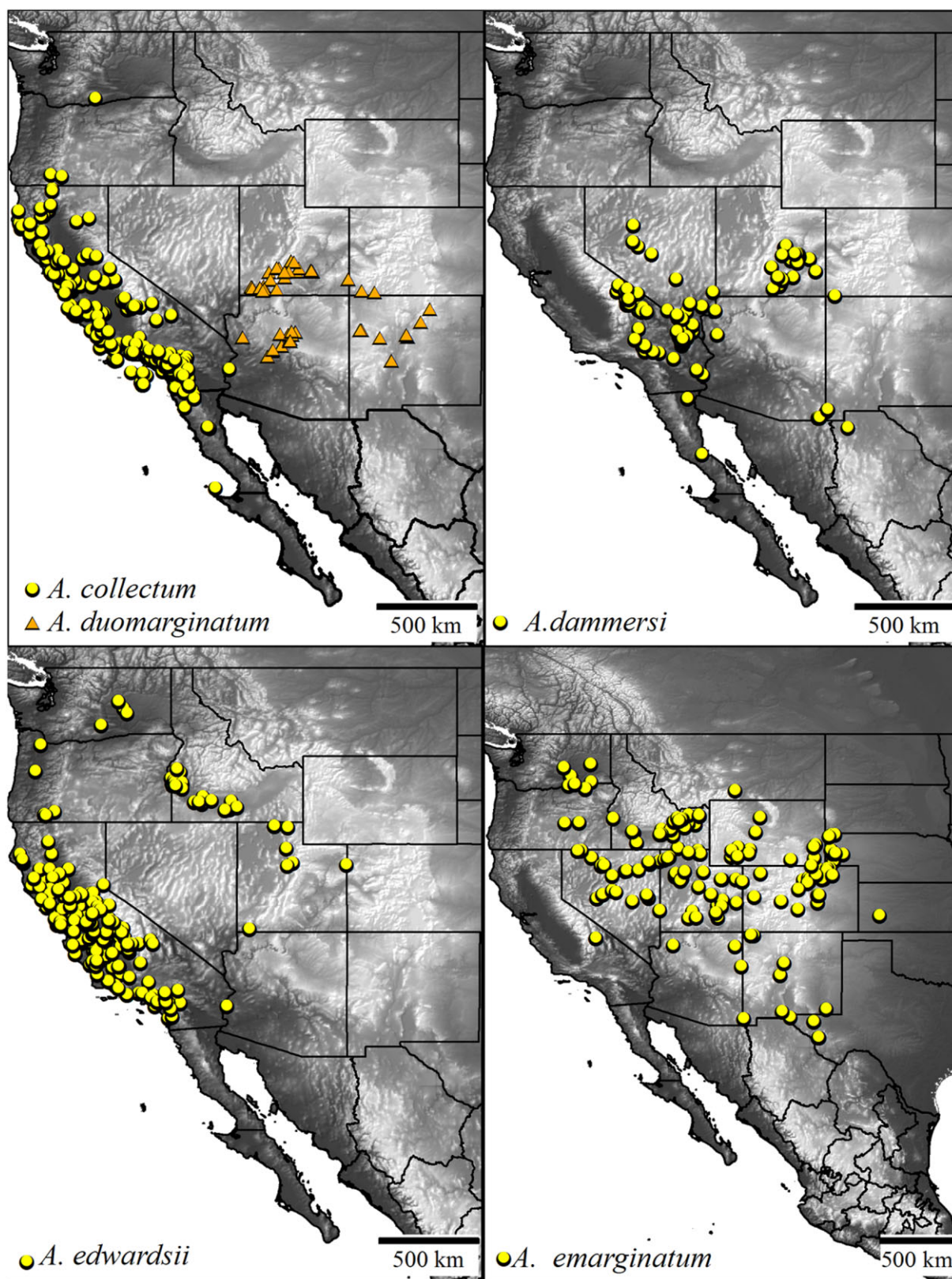
**Figure 576.** Collection localities for North American species of *Anthidium*.



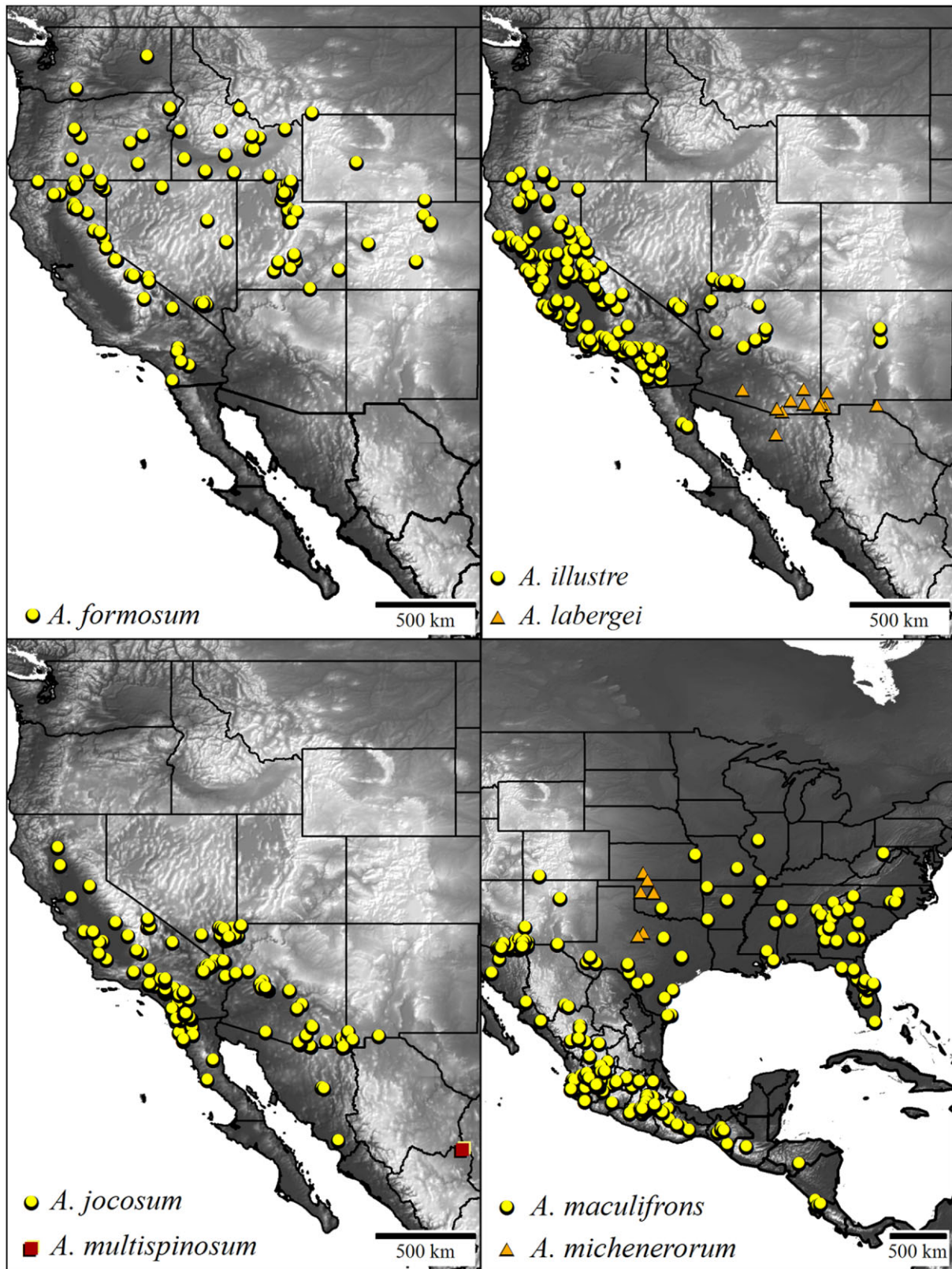


**Figure 577.** Collection localities for North American species of *Anthidium*.



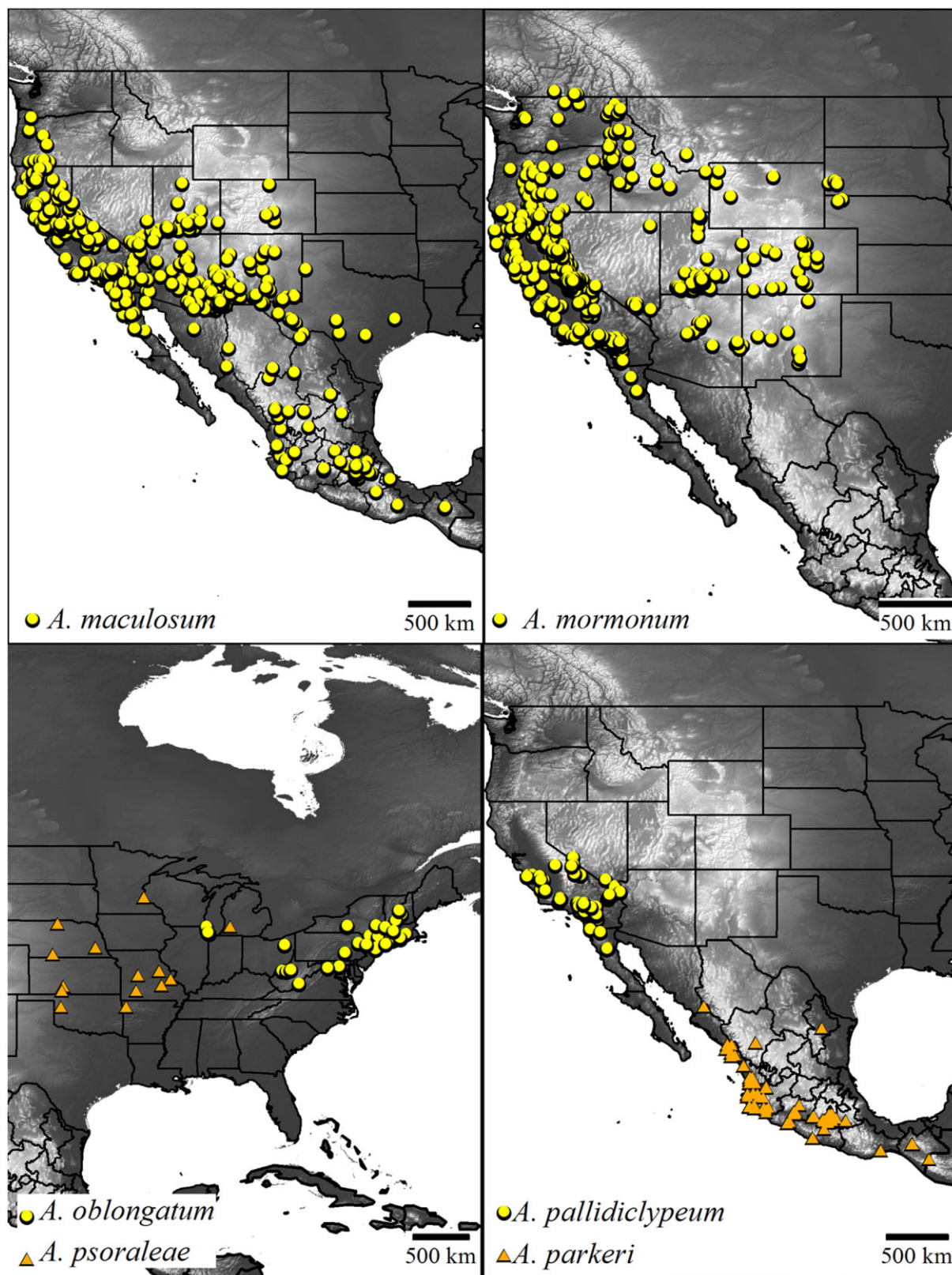


**Figure 578.** Collection localities for North American species of *Anthidium*.



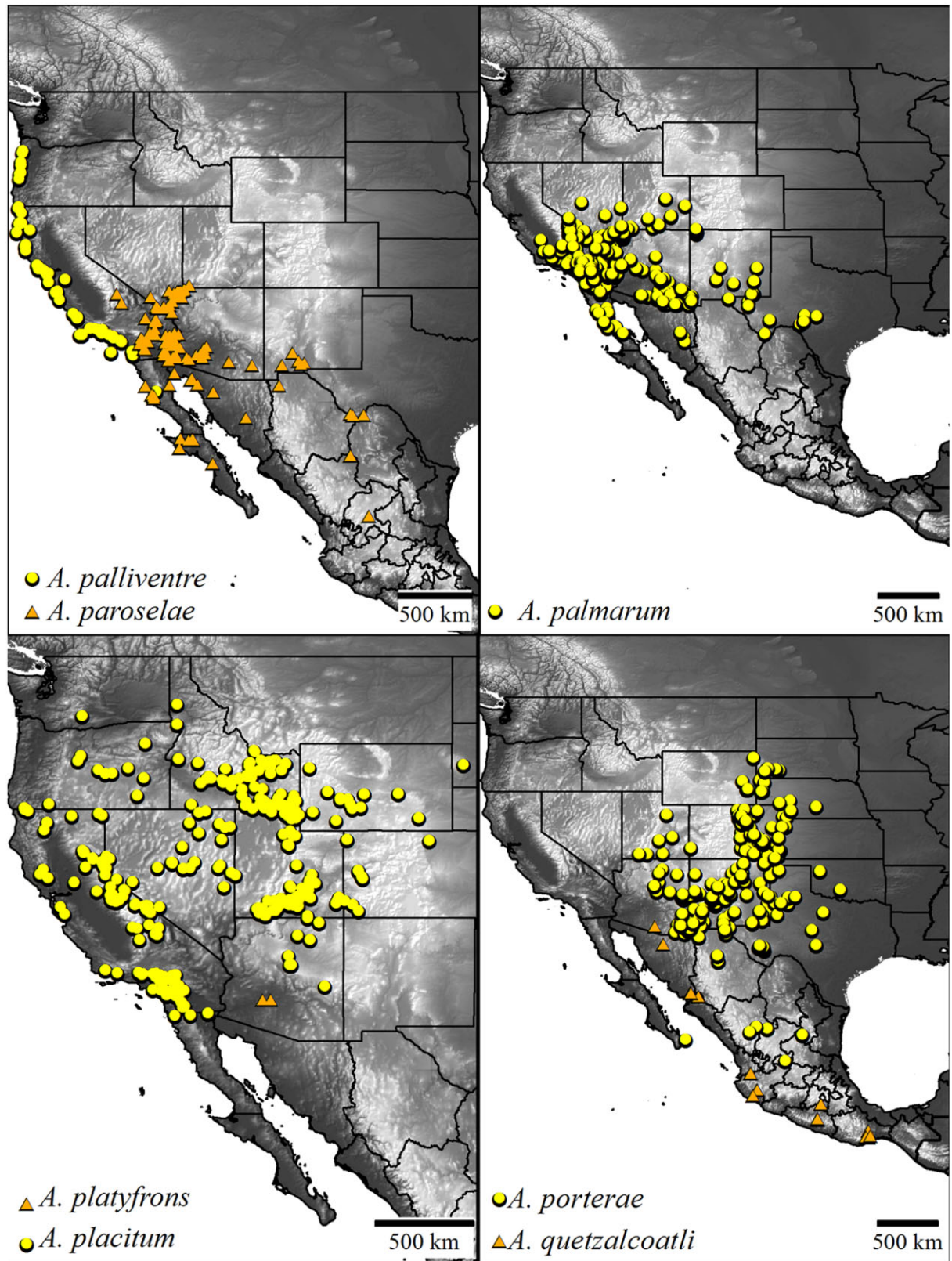
**Figure 579.** Collection localities for North American species of *Anthidium*.



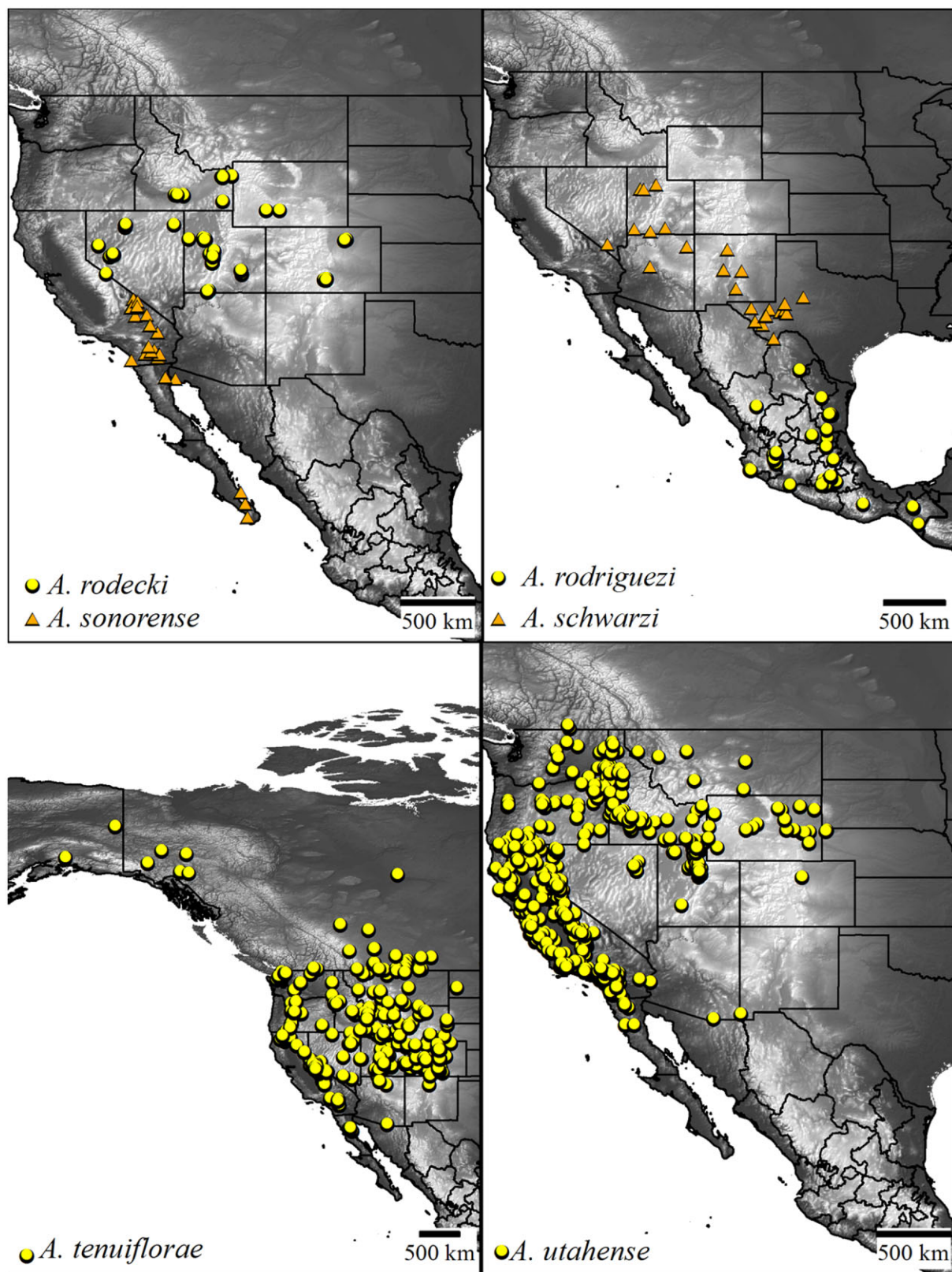


**Figure 580.** Collection localities for North American species of *Anthidium*.



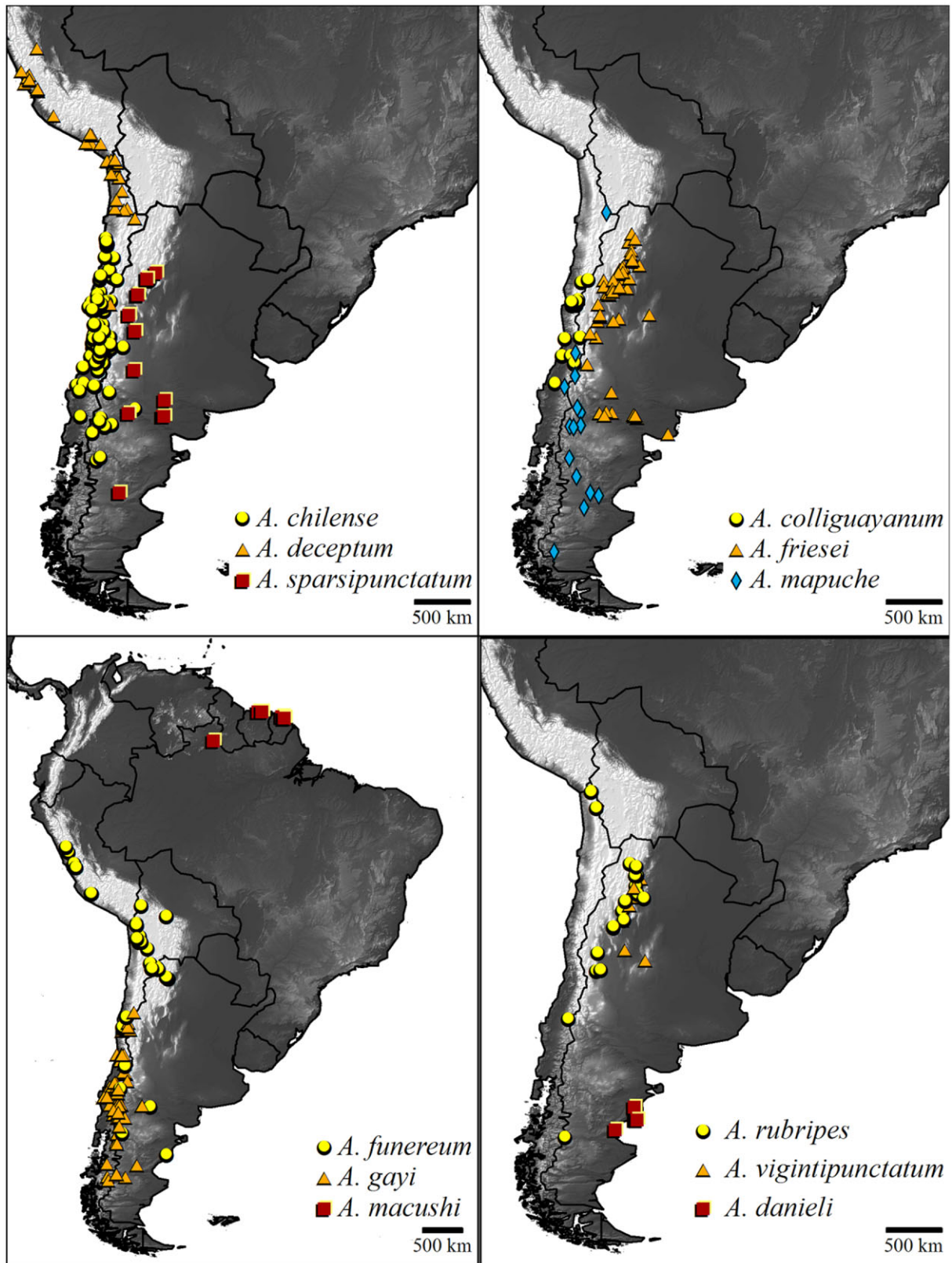


**Figure 581.** Collection localities for North American species of *Anthidium*.



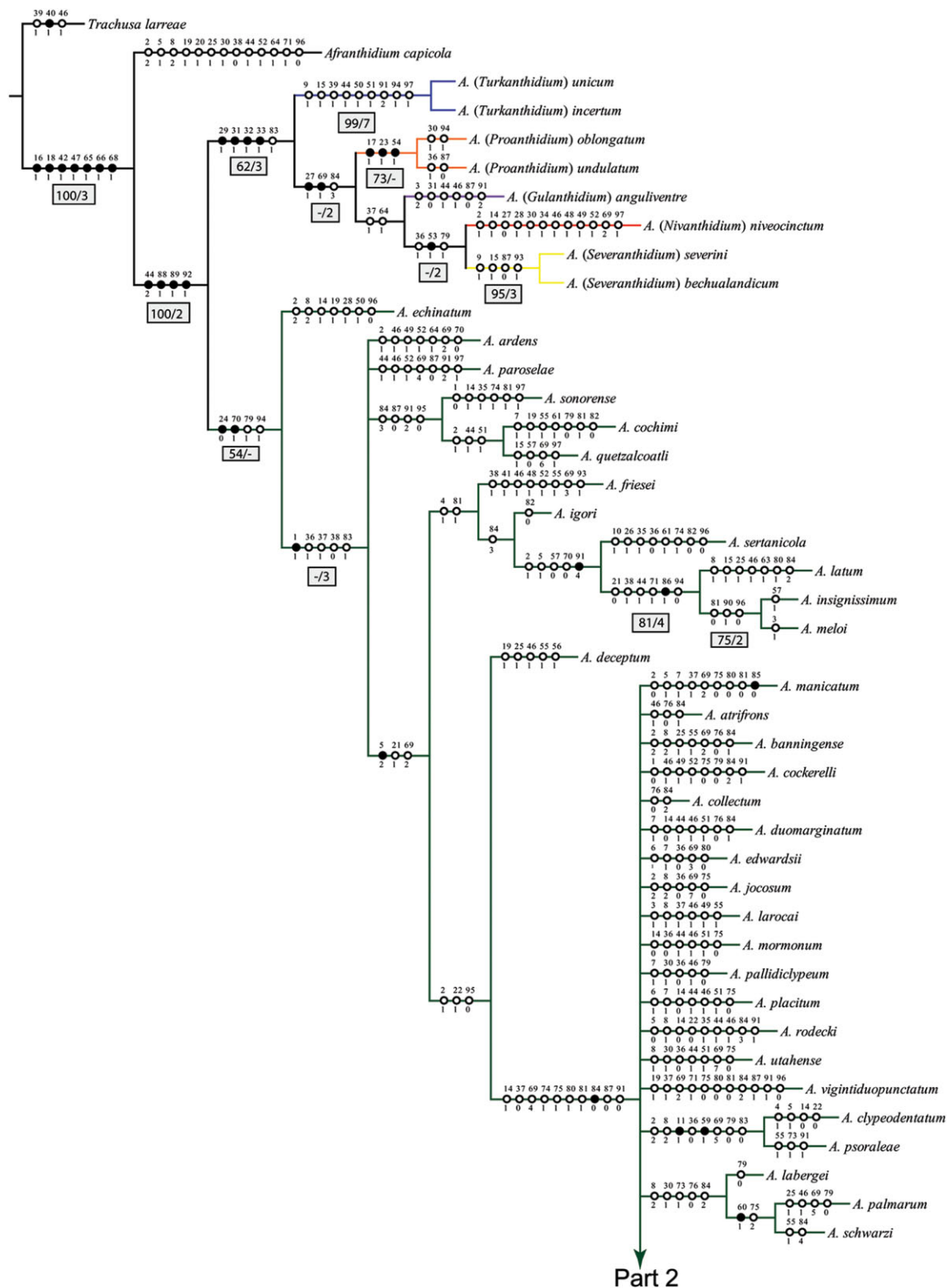
**Figure 582.** Collection localities for North American species of *Anthidium*.





**Figure 583.** Collection localities for South American species of *Anthidium*.





**Figure 584.** Strict consensus tree of 239 most parsimonious trees. Black circles indicate unique changes; white circles indicate homoplastic changes; character numbers are placed above each change, character states below. Numbers in shaded boxes are bootstrap and Bremer's support values. Branches without numbers or with a dash indicate bootstrap values below 50% and Bremer values of 1.

## Part 1

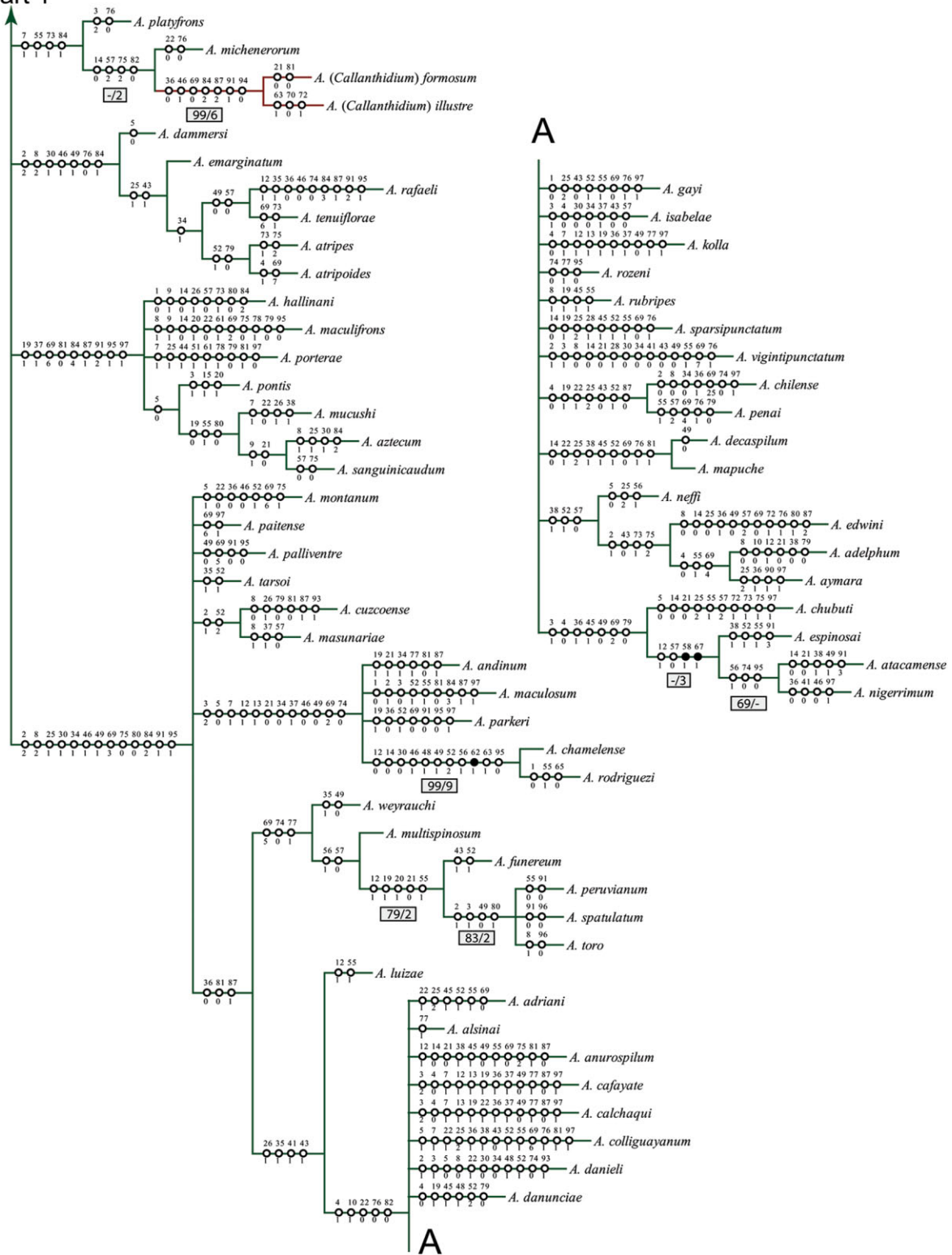
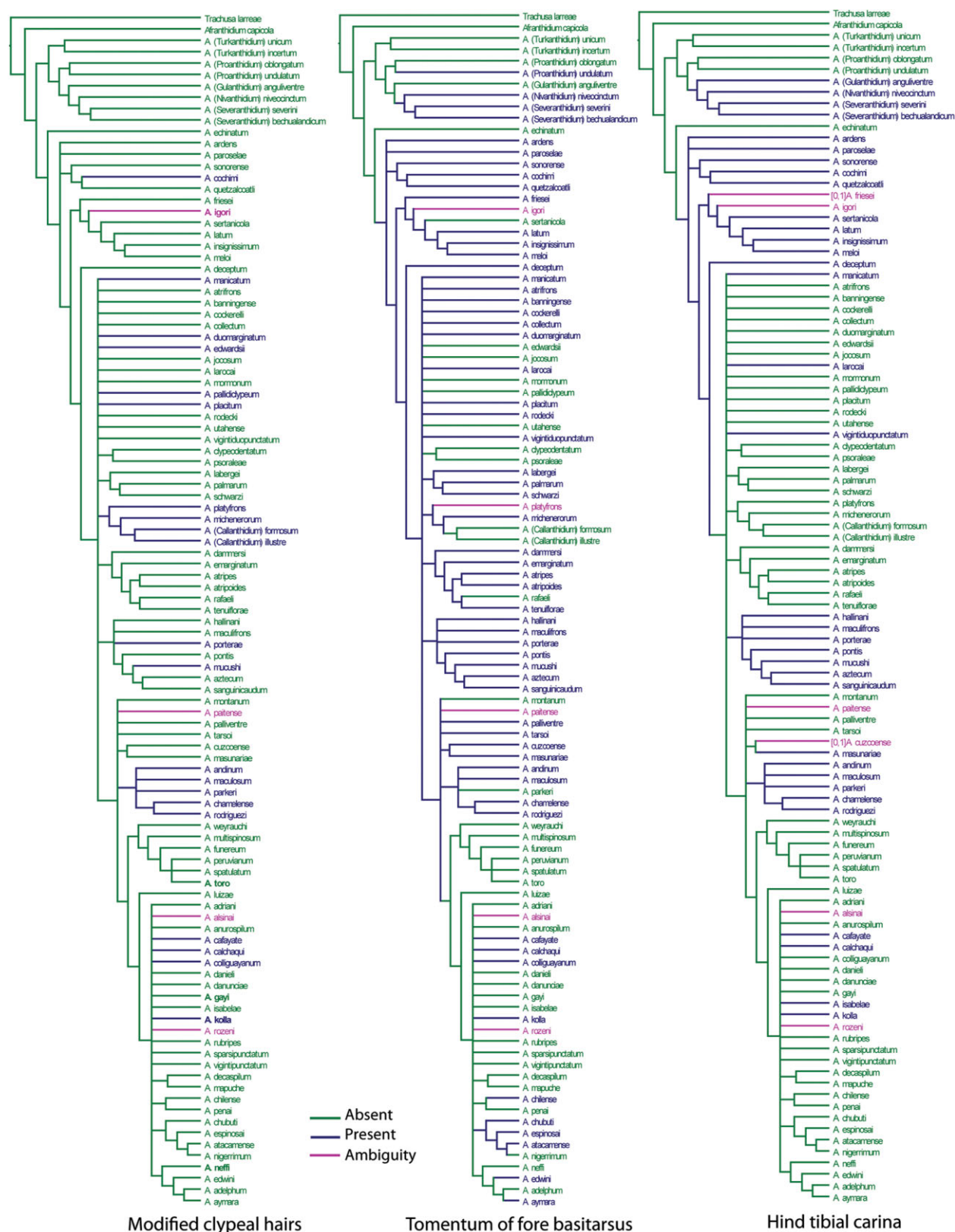
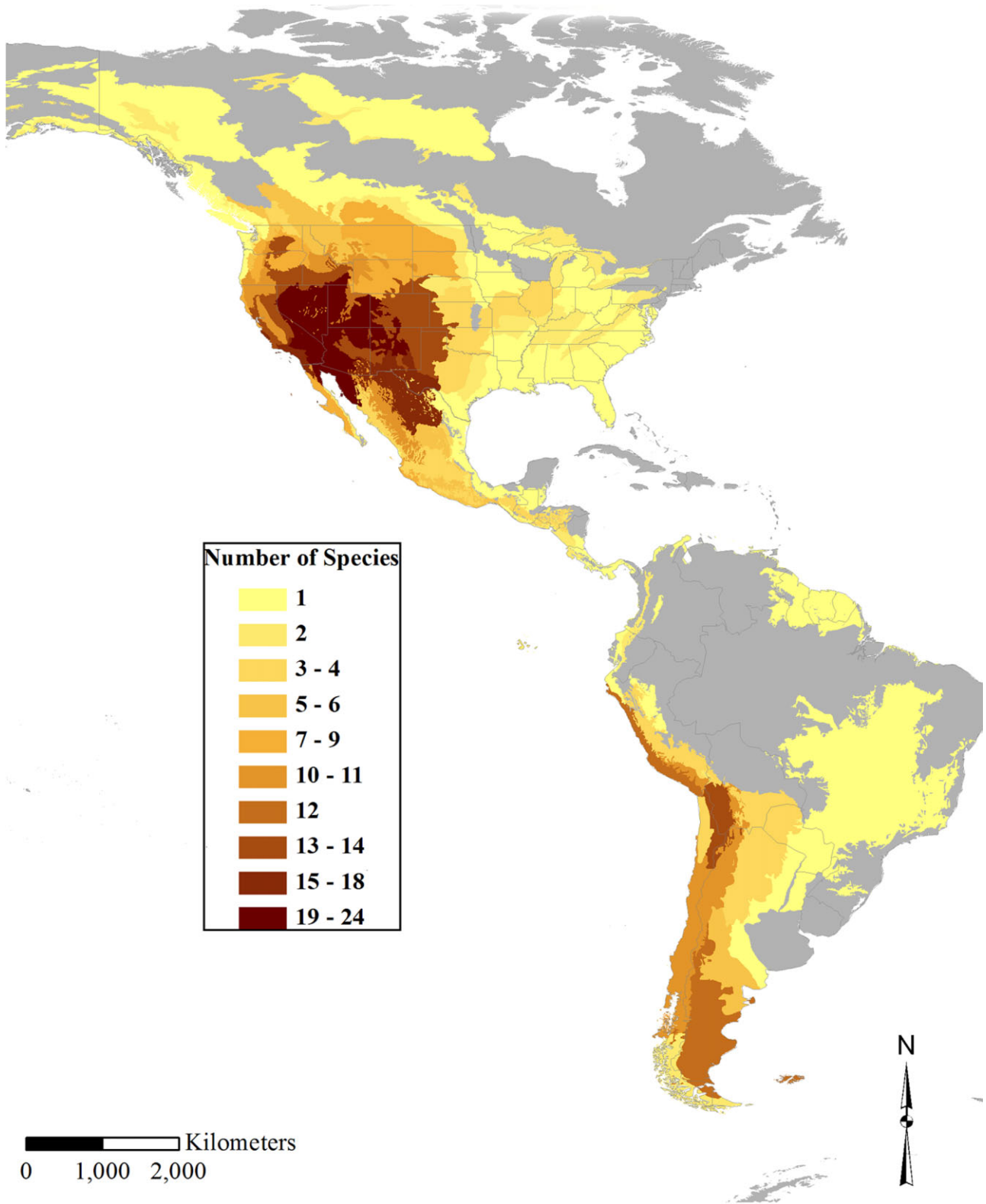


Figure 584. Continued



**Figure 585.** Characters 7 (modified clypeal hairs), 36 (presence of dense tomentum on outer surface of fore basitarsus), and 37 (hind tibial carina) mapped onto the strict consensus tree.





**Figure 586.** Diversity and distribution of *Anthidium* in the New World. The darker the colour, the more species coexist in the same area, as indicated by the legend.

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#### SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article at the publisher's web-site:

**Appendix S1.** Character matrix used in cladistic analysis of *Anthidium* (see Material and Methods).



**Supporting Information.** Appendix S1. Character matrix used in cladistic analysis of the *Anthidium*. -, not applicable; ?, state of character that could not be recorded; \*, \$, multistate (see Material and methods).

**TABLE 1. Characters 1 - 45**

	1	5	10	15	20	25	30	35	40	45
Trachusa larreae	0	0	0	0	0	0	0	0	0	0
Afranthidium capicola	0	2	0	0	0	0	0	0	0	0
A. manicatum	1	0	0	0	0	0	0	0	0	0
A. espinosai	1	2	0	0	2	0	1	0	1	0
A. echinatum	0	2	0	0	0	0	0	0	0	0
A. montanum	1	2	0	0	0	0	0	0	0	0
A. pontis	1	1	0	0	0	0	0	0	0	0
A. ardens	1	1	0	0	0	0	0	0	0	0
A. (Callanthidium) formosum	1	1	0	0	0	0	0	0	0	0
A. (Callanthidium) illustre	1	1	0	0	0	0	0	0	0	0
A. (Gulanthidium) anguliventre	0	0	2	0	0	0	0	0	0	0
A. (Nivanthidium) niveocinctum	0	1	0	0	0	0	0	0	0	0
A. (Proanthidium) oblongatum	0	\$	0	0	0	0	0	0	0	0
A. (Proanthidium) undulatum	0	0	0	0	0	0	0	0	0	0
A. (Severanthidium) severini	0	0	0	0	0	0	0	0	0	0
A. (Severanthidium) bechualandicum	0	0	0	0	0	0	0	0	0	0
A. (Turkanthidium) unicum	0	0	0	0	0	0	0	0	0	0
A. (Turkanthidium) incertum	0	0	0	0	0	0	0	0	0	0
A. adelphum	1	1	0	0	0	0	0	0	0	0
A. adriani	1	2	0	0	2	0	1	0	0	0
A. alsinai	?	?	?	?	?	?	?	?	?	?
A. andinum	1	2	0	0	1	1	0	1	0	0
A. anurospilum	1	2	0	0	2	0	1	0	0	0
A. atacamense	1	2	0	0	2	0	1	0	0	0
A. atrifrons	1	\$	0	0	2	0	0	0	0	0
A. atripes	1	2	0	0	2	0	0	0	0	0
A. atripoides	1	2	0	0	2	0	0	0	0	0
A. aymara	1	\$	0	0	2	0	0	0	0	0
A. aztecum	1	1	0	0	0	0	0	0	0	0
A. banningense	1	2	0	0	2	0	0	0	0	0
A. cafayate	1	2	2	0	1	2	0	1	1	0

A. calchaqui	122020120100110101101100110001000111100011*20
A. chamelense	1220001200001001010-0-00100000000001100001020
A. chilense	100020000100010101101100210001000011000011020
A. chubuti	1210000201000001010-0-00210001000111000011121
A. clypeodentatum	1\$01100\$00100001010-100000000000000000001020
A. cochimi	110000100000000101100000000000000001100001010
A. cockerelli	0100200000000101010-1100000000000001000001020
A. collectum	1100200000000101010-1100000000000001000001020
A. colliguayanum	1201101201000101010-1100210001000111010011020
A. cuzcoense	1100200000000101010-1100110001000101*00001020
A. dammersi	1200000200000101010-1100000001000001000001020
A. danieli	1111000001000101010-1100110000000010000011120
A. danunciae	120020020100010101101000110001000110000011121
A. decaspilum	1201200201000001010-1100210001000110010011121
A. deceptum	110020000000000101101100100000000001100001020
A. duomarginatum	1100201000000001010-1100000000000001000001010
A. edwardsii	1100211000000101010-1100000000000000000001020
A. edwini	1101200001000001010-1000010001000111010011020
A. emarginatum	1200200200000101010-1100100001000001000001120
A. friesei	1001200000000001010-1000000000000001*10011020
A. funereum	1200\$0020001010101110-00100001000100000001120
A. gayi	0201200201000*01010-1000210001000110000011020
A. hallinani	010020001000000101101100010000000001100001020
A. igori	????????????????????????????????0000??????00??2?
A. insignissimum	1101100000000001010-0-00000000000001110001010
A. isabelae	1210200201000101010-??00110000000010100011020
A. jocosum	1200200200000101010-1100000000000000000001020
A. kolla	120020120101110101101000110001000111100011120
A. labergei	1100200200000101010-1100000001000001000001020
A. larocai	1110200100000101010-1100000000000001100001020
A. latum	1101100100000011010-0-00100000000001110001010
A. luizae	1200200200010101010-1100110001000110000011120
A. maculifrons	110020011000000101110000000000000001100001020
A. maculosum	0100001200011101010-0-00100001000001100001020
A. mucushi	1100001000000101010-1000010000000001110001020
A. mapuche	1201200201000001010-1100210001000110010011121
A. masunariae	1100200100000101010-1100100001000101100001020

A. meloi	1111100000000001010-0-0000000000001110001010
A. michenerorum	1100201000000001010-1000000000000001000001020
A. mormonum	1100200000000001010-110000000000000000001010
A. multispinosum	1200200200000101010-1100100001000100000001020
A. neffi	1201000201000101010-1000210001000110010011120
A. nigerrimum	121020020*010101010-10001*0001000110000001121
A. paitense	?????????????0?????????????????00?000? ?????00???
A. pallidiclypeum	11002*1000000101010-1100000001000000000001020
A. palliventre	1200200200000101010-1100100001000101000001020
A. palmarum	1100200\$00000101010-11001*00010000*1000001020
A. parkeri	1\$20001\$0001110101100-00100001000000100001020
A. paroselae	1000000000000001010-0-00000000000001100001010
A. penai	120020020100010101101100210001000110000011020
A. peruvianum	111020020001010101110-00100001000100000001020
A. placitum	1100211000000001010-1100000000000001000001010
A. platyfrons	1120201000000101010-110000000000000?000001020
A. porterae	110020100000010101101100100000000001100001010
A. psoraleae	1200200200100101010-1100\$00000000000000001020
A. quetzalcoatli	11000000000000011010-0-00000000000001100001010
A. rafaeli	1200200200010101010-1100100001000110000001120
A. rodecki	1100000100000001010-10000000000000011000001010
A. rodriguezi	0220001-00001001010-0-00100000000001100001020
A. rozeni	?????????????????????????????????00?000? ?????01???
A. rubripes	120120010100010101101000\$10001000110000011121
A. sanguinicaudum	1100000010000101010-0-00000000000001100001020
A. schwarzi	1\$00200\$00000101010-1100000001000001000001020
A. sertanicola	1101100001000001010-10000100000000010100001020
A. sonorensis	0000000000000101010-0-000000000000011100001020
A. sparsipunctatum	120120020100000101101000210101000110000011121
A. spatulatum	111020020001010101110-00100001000100000001020
A. tarsoi	120020020000010101????00100001000111000001020
A. tenuiflorae	1200200200000101010-1100100001000101000001*20
A. toro	111020010001010101110-00100001000100000001020
A. utahense	1100200100000101010-1100000001000000000001010
A. vigintiduopunctatum	110020000000010101101100000000000001100001020
A. vigintipunctatum	1111200001000001010-0-00110100000010000001020
A. weyrauchi	1200200200000101010-1100100001000110000001020



TABLE 2. Characters 46 - 90

	50	55	60	65	70	75	80	85	90
Trachusa larreae	10	--00	000010000000000000	000000	--0000	0	0	--0100	-
Afranthidium capicola	01	000010000100000001	1101001000	--000	0	0	--0100	-	
A. manicatum	01	000000000100000001	11012100010100100	-10000	110				
A. espinosai	11	000010010010000001	111121000100000	0	-12	-01110			
A. echinatum	01	001000000100000001	1101010000	--00100	0	--01110			
A. montanum	01	010010000100000001	11016100011100101112	-00110					
A. pontis	01	00000000010000	???1101610	?????00110	-	????????			
A. ardens	11	01001000010000001	1101200000	--00100	-12	-	?????		
A. (Callanthidium) formosum	11	000000010200000001	11010100112100110	-12	-02110				
A. (Callanthidium) illustre	11	000000010200000101	11010001112100111012	-02110					
A. (Gulanthidium) anguliventre	11	00000000010000001	11011100000	--000	0	-13	-00110		
A. (Nivanthidium) niveocinctum	11	11001100010000001	1101200000	--00100	-13	-01110			
A. (Proanthidium) oblongatum	01	000000100100000001	11011100000	--000	0	-13	-01110		
A. (Proanthidium) undulatum	01	000000100100000001	11011100000	--000	0	-13	-00110		
A. (Severanthidium) severini	01	00000100010000001	11011100000	--00100	-13	-00110			
A. (Severanthidium) bechualandicum	01	00000100010000001	11011100000	--00100	-13	-00110			
A. (Turkanthidium) unicum	01	001100000100000001	1101000000	--000	0	-12	-01110		
A. (Turkanthidium) incertum	01	001100000100000001	1101000000	--000	0	-12	-01110		
A. adelphum	11	010010010000000001	110141001120000	0	-12	-01110			
A. adriani	11	010010010100000001	11010100010000100	-12	-01110				
A. alsinai	?	1??00?0????????0001	11013100010010100	-12	-0	?????			
A. andinum	01	000000000100000001	1101210000	--10100	-12	-01110			
A. anurospilum	11	000000010100000001	11010100012000101012	-00110					
A. atacamense	11	010000001010000001	1111210000	--000	0	-12	-01110		
A. atrifrons	11	000000000100000001	11014100011000111111	-00110					
A. atripes	11	010010000100000001	110141001120000	-1111	-00110				
A. atripoides	11	010010000100000001	110171000110000	-1111	-00110				
A. aymara	11	010010010000000001	11014100112000100	-12	-01111				
A. aztecum	01	000000010100000001	11016100011100100	-12	-01110				
A. banningense	01	000000010100000001	11012100011000111111	-00110					
A. cafayate	11	000000000100000001	1101\$100010010100	-12	-00110				
A. calchaqui	11	000000000100000001	11013100010010100	-12	-00110				

A. chamelense	11110020001100001101101210000--00101112-00110
A. chilense	11010010000100000001101\$10000--00100-1--00110
A. chubuti	1100000001020000000110121011110000-0-12-01110
A. clypeodentatum	0100000000010100000110151000111000-110--00110
A. cochimi	01000100010100010001101010000--000-1013-00110
A. cockerelli	1101001000010000000110141000101000-1112-00110
A. collectum	010000000001000000011014100011000111112-00110
A. colliguayanum	110100100101000000011016100010100101012-01110
A. cuzcoense	1101002000010000000110131000101000-0-12-01110
A. dammersi	110100000001000000011014100011000111111-00110
A. danieli	11110010000100000001101310000--00100-12-01110
A. danunciae	111-002000010000000110131000100000-0-12-01110
A. decaspilum	110000100001000000011010100010100101012-01110
A. deceptum	11000000011100000001101210000--00100-12-01110
A. duomarginatum	110001000001000000011014100011000111111-00110
A. edwardsii	010000000001000000011013100011100101110100110
A. edwini	110000100002000000011010101112100110-12-02110
A. emarginatum	110100000001000000011014100011000111111-00110
A. friesei	111-0010010100000001101310000--00101112-01110
A. funereum	11010010011000000001101510000--10100-12-01110
A. gayi	110100100101000000011010100010100100-12-01110
A. hallinani	010000000000000000011016100111100100-12-01110
A. igori	?1??00?0????????0001101210000--00101013-01110
A. insignissimum	01000000000100000001101201000--00100-13-11111
A. isabelae	1101000000000000????????????????????????????
A. jocosum	010000000001000000011017100010100111110100110
A. kolla	110000000001000000011013100010010100-12-01110
A. labergei	0100000000010000000110141001110000-1112-00110
A. larocai	1101000001010000????????????????????????????
A. latum	1100000000000000000101101201000--00111112-11110
A. luizae	1101000001010000????????????????????????????
A. maculifrons	0100000000010001000110121000101010-0-14-01110
A. maculosum	01000010010100000001101210000--00100-13-01110
A. mucushi	010000000101000000011016100011100100-14-01110
A. mapuche	110100100001000000011010100010100101012-01110
A. masunariae	1101002000000000????????????????????????????
A. meloi	01000000000000000001101201000--00100-13-11111

A. michenerorum	010000000102000000011014100112000111011-00110
A. mormonum	11000100000100000*011014100010100111110100110
A. multispinosum	1101000000100000????????????????????????
A. neffi	1101001000100000????????????????????????
A. nigerrimum	01000000001010000001111210000--000-0-12-01110
A. paitense	?1??00?0???????00011016100010100101112-00110
A. pallidiclypeum	1100000000010000000110141000111000-1110100110
A. palliventre	110000000001000000011015100010100101112-00110
A. palmarum	1100000000010010000110151001120000-1112-00110
A. parkeri	01000010000100000001101010000--00101112-00110
A. paroselae	11000010000100000001101410000--00100-12-00110
A. penai	1101001001020000000110141000101000-0-12-00110
A. peruvianum	11000000001000000001101510000--10110-12-01110
A. placitum	110001000001000000011014100010100111110100110
A. platyfrons	010000000101000000011014100111000111111-00110
A. porterae	0100010000010001000110161000111010-1114-01110
A. psoraleae	0100000001010100000110151001111000-110--00110
A. quetzalcoatli	01000100000000000001101610000--00100-13-00110
A. rafaeli	01000000000000000001101410000--00111113-01110
A. rodecki	110000000001000000011014100011100111113-00110
A. rodriguezii	11110020011100001100101210000--00101112-00110
A. rozeni	?1??00?0???????0001101310000--10100-12-01110
A. rubripes	110100000101000000011015100010000100-12-01110
A. sanguinicaudum	010000000100000000011016100010100100-14-01110
A. schwarzi	010000000101001000011014100112000111114-00110
A. sertanicola	0100000000000000100011012000010100101013-01110
A. sonorensis	010000000001000000011010100010100101113-00110
A. sparsipunctatum	110100100101000000011010100010100100-12-01110
A. spatulatum	11000000011000000001101510000--10110-12-01110
A. tarsoi	1101001000010000????????????????????????
A. tenuiflorae	110000000000000000011016100111000111111-00110
A. toro	11000000011000000001101510000--10110-12-01110
A. utahense	010001000001000000011017100010100111110100110
A. vigintiduopunctatum	010000000001000000011012110010100100-12-01110
A. vigintipunctatum	110000000101000000011017100010100100-12-01110
A. weyrauchi	11000000000100000001101510000--10100-12-01110



TABLE 3. Characters 91 - 97

	91	97
Trachusa larreae	1000-10	
Afranthidium capicola	1000-0-	
A. manicatum	0101010	
A. espinosai	3101110	
A. echinatum	110110-	
A. montanum	1101110	
A. pontis	???????	
A. ardens	???????	
A. (Callanthidium) formosum	1100-10	
A. (Callanthidium) illustre	1100-10	
A. (Gulanthidium) anguliventre	2100-10	
A. (Nivanthidium) niveocinctum	1100-11	
A. (Proanthidium) oblongatum	1101110	
A. (Proanthidium) undulatum	1100-10	
A. (Severanthidium) severini	1110-10	
A. (Severanthidium) bechualandicum	1110-10	
A. (Turkanthidium) unicum	2101111	
A. (Turkanthidium) incertum	2101111	
A. adelphum	1101110	
A. adriani	1101110	
A. alsinai	???????	
A. andinum	1101110	
A. anurospilum	1101110	
A. atacamense	3101010	
A. atrifrons	0101010	
A. atripes	0101010	
A. atripoides	0101010	
A. aymara	1101111	
A. aztecum	2101111	
A. banningense	0101010	
A. cafayate	1101111	
A. calchaqui	1101111	
A. chamelense	1101010	

A. chilense	1101111
A. chubuti	1101111
A. clypeodentatum	0101010
A. cochimi	2101010
A. cockerelli	1101010
A. collectum	0101010
A. colliguayanum	1101111
A. cuzcoense	1111110
A. dammersi	0101010
A. danieli	1111110
A. danunciae	1101110
A. decaspilum	1101110
A. deceptum	1101010
A. duomarginatum	0101010
A. edwardsii	0101010
A. edwini	1101110
A. emarginatum	0101010
A. friesei	1111110
A. funereum	1101110
A. gayi	1101111
A. hallinani	2101111
A. igori	1101110
A. insignissimum	4100-0-
A. isabelae	???????
A. jocosum	0101010
A. kolla	1101111
A. labergei	0101010
A. larocai	???????
A. latum	4100-10
A. luizae	???????
A. maculifrons	2101011
A. maculosum	1101111
A. mucushi	2101111
A. mapuche	1101110
A. masunariae	???????
A. meloi	4100-0-
A. michenerorum	0101010

A. mormonum	0101010
A. multispinosum	???????
A. neffi	???????
A. nigerrimum	1101011
A. paitense	1101111
A. pallidiclypeum	0101010
A. palliventre	0101010
A. palmarum	0101010
A. parkeri	0101011
A. paroselae	2101111
A. penai	1101110
A. peruvianum	0101110
A. placitum	0101010
A. platyfrons	0101010
A. porterae	2101110
A. psoraleae	1101010
A. quetzalcoatli	2101011
A. rafaeli	2101110
A. rodecki	1101010
A. rodriguezi	1101010
A. rozeni	1101010
A. rubripes	1101110
A. sanguinicaudum	2101111
A. schwarzi	0101010
A. sertanicola	410110-
A. sonorensis	2101011
A. sparsipunctatum	1101110
A. spatulatum	010110-
A. tarsoi	???????
A. tenuiflorae	0101010
A. toro	110110-
A. utahense	0101010
A. vigintiduopunctatum	110100-
A. vigintipunctatum	1101110
A. weyrauchi	1101110



**SUMMARY PERCENTAGES**

MISSING (?): 501 cells, 4 percent of matrix.  
DASHES (-): 394 cells, 3 percent of matrix.  
TOTAL POLYMORPHISM (\$ , \*): 29 cells, 0 percent of matrix.  
TOTAL FULL AMBIGUITY (? , -): 895 cells, 8 percent of matrix.  
TOTAL FULL + PARTIAL AMBIGUITY (? , -, \*, \$): 924 cells, 9 percent of matrix.  
STATE (0): 5788 cells, 56 percent of matrix.  
    STATE (0) EMBEDDED IN POLYMORPHISM: 18 cells, 0 percent of matrix.  
STATE (1): 3030 cells, 29 percent of matrix.  
    STATE (1) EMBEDDED IN POLYMORPHISM: 25 cells, 0 percent of matrix.  
STATE (2): 363 cells, 3 percent of matrix.  
    STATE (2) EMBEDDED IN POLYMORPHISM: 13 cells, 0 percent of matrix.  
STATE (3): 27 cells, 0 percent of matrix.  
    STATE (3) EMBEDDED IN POLYMORPHISM: 2 cells, 0 percent of matrix.  
STATE (4): 29 cells, 0 percent of matrix.  
STATE (5): 9 cells, 0 percent of matrix.  
    STATE (5) EMBEDDED IN POLYMORPHISM: 1 cells, 0 percent of matrix.  
STATE (6): 11 cells, 0 percent of matrix.  
STATE (7): 4 cells, 0 percent of matrix.