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New records and diagnostic notes on large carpenter bees
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River basin of South America

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Abstract. Previously unpublished museum specimen records are presented for 23 species of the genus *Xylocopa* Latreille (Hymenoptera: Apidae) collected in portions of the countries of Bolivia, Brazil, Peru, and Venezuela within the Amazon River basin of South America. Dichotomous keys and dorsal habitus photographs are provided for the identification of females of the 13 species of *Xylocopa* subgenus *Neoxylocopa* Michener, and females of the 10 species of *Xylocopa* subgenus *Schonnherria* Lepelletier, that have been recorded to date from the Amazon River basin.

Key words. Identification, key, illustration, distribution, pollinator.

Introduction

Large carpenter bees, species of the genus *Xylocopa* Latreille (Hymenoptera: Apidae), represent one of the larger evolutionary lineages of bees, with over 700 species-level taxa described to date (Michener 2007). Many species of *Xylocopa* are known to be important pollinators of agricultural crops, particularly in tropical regions of the world where this genus has greatest species diversity (Kearse 2010). In the New World tropics, crops of economic importance which are pollinated by these bees include passion fruit, *Passiflora edulis* Sims (Passifloraceae), and the Brazil nut tree, *Bertholletia excelsa* Humboldt and Bonpland (Lecythidaceae) (Dominguez-Gil and McPheron 1992; Motta Maués 2002). Neotropical species of *Xylocopa* have also been recorded visiting flowers of crop plants such as alfalfa, *Medicago sativa* L. (Fabaceae); coffee, *Coffea* L. sp. (Rubiaceae); cowpea, *Vigna unguiculata* (L.) Walpers (Fabaceae); ginger, *Zingiber* Miller sp. (Zingiberaceae); pumpkins and squash, *Cucurbita* L. sp. (Cucurbitaceae); sweet pea, *Lathyrus odoratus* L. (Fabaceae), and tomato, *Solanum lycopersicum* L. (Solanaceae), among numerous other flowering plant taxa (Hurd 1978; Kearse 2010; Mawdsley 2017). In addition to pollinating agricultural crops, large carpenter bees also visit and pollinate flowers of many indigenous tree and shrub species (Hurd and Moure 1963; Janzen 1966; Hurd 1978).

Despite the importance of these bees as pollinators, the identification of individual species of the genus *Xylocopa* can be extremely difficult, due in part to the large number of species in the genus, and also due to the strong similarities between many of these species in external characteristics of pigmentation and pubescence (Hurd and Moure 1963; Hurd 1978). To compound the confusion, males and females of individual *Xylocopa* species often differ significantly in their external appearance, in many cases to such an extent that the different sexes of a single species were actually described as separate species by earlier taxonomists (Hurd and Moure 1963; Hurd 1978). In certain lineages, the males and females of a single species are so dissimilar that they can only be associated by the direct observation of mating or nesting behaviors, by the rearing of individuals from the same nest, or by use of relatively novel molecular systematics techniques such as DNA barcoding.

While curating the specimens of Neotropical carpenter bees in the collections of the U. S. National Museum of Natural History (USNM), Smithsonian Institution, I discovered several drawers of unsorted

specimens of species of the genus *Xylocopa* which had been collected at localities within the Amazon River basin in South America (defined by Goulding et al. 2003 to include that portion of South America which is drained by the Amazon River and its tributaries). This material was not part of the main collection of bees used by Hurd (1978) and Hurd and Moure (1963) in their major revisionary studies. Some of these specimens had been identified by Hurd and/or Moure after the publication by Hurd (1978), while others had been identified by other workers.

Because there are relatively few detailed locality records of *Xylocopa* species from the Amazon River basin in online bee specimen databases (e.g., <http://www.discoverlife.org>, although coarse-scale distribution maps for these species are available in Moure 2012), and because of the importance of these bees as pollinators of tropical rainforest trees and agricultural crop species, I felt that a short paper summarizing these new records would be an appropriate contribution to our knowledge of this genus. In addition to these new records and associated notes, I provide provisional keys for the identification of the females of the Amazon basin species of the subgenera *Xylocopa* (*Neoxylocopa* Michener) and *Xylocopa* (*Schonnherria* Lepageletier). The males of species in these groups can be identified largely on the basis of their reproductive structures (many of which were illustrated by Hurd and Moure 1963), but the females of these groups are very similar in appearance and are often difficult to identify accurately to species. Accordingly, dorsal habitus photographs of accurately identified female specimens of all Amazon basin species of *X. (Neoxylocopa)* and *X. (Schonnherria)* are also provided here.

Xylocopa (Neoxylocopa) and *X. (Schonnherria)* are the two main lineages of the genus *Xylocopa* that occur within the Amazon River basin. One additional species, *X. (Stenoxylocopa) ruficollis* Hurd and Moure (1963: 293–294), was described from specimens collected at localities in the Brazilian and Peruvian Amazon. Keys for the separation of males and females of all three of these subgenera can be found in Michener (2007: 599–601). At this writing, the Michener (2007) book can be found in its entirety on the World Wide Web at: <http://base.dnsgb.com.ua/files/book/Agriculture/Beekeeping/Thep-Bees-of-the-World.pdf>.

Materials and Methods

The following notes and illustrations are based on specimens of species of *Xylocopa* contained in the collection of the National Museum of Natural History, Smithsonian Institution (USNM). The late Smithsonian entomologist Paul D. Hurd assembled a very large collection of pinned large carpenter bees in preparation for his own taxonomic studies of the genus *Xylocopa* (e.g., Hurd and Moure 1963, Hurd 1978). The bulk of the material which is included in the present paper had been placed by Hurd in the general drawers of mostly unidentified specimens at the end of the main USNM collection of *Xylocopa*. Some of these specimens had been labeled by Hurd with species names; others have since been identified by other workers, particularly J. S. Moure. In the species accounts that follow, I provide collecting data from the labels accompanying the specimens that I examined, in order to make this information generally available to other workers who are studying and mapping distribution patterns in *Xylocopa* and other bee taxa. For comparison, I also present summaries of the known distributional information for these species from the catalogs of Hurd (1978) and Moure (2012). The provisional keys to females of *X. (Neoxylocopa)* species and females of *X. (Schonnherria)* species are based on specimens in the USNM collection which have been authoritatively identified by P. D. Hurd and/or J. S. Moure. The keys are intentionally based on external characters that can be readily observed by readers who have a general background in entomology, but do not necessarily have a specialized knowledge of bee taxonomy. The subgeneric taxonomy and the spelling of the subgeneric taxa in this paper follows that of Michener (2007), who also provided keys to males and females of all New World subgenera of *Xylocopa*. I follow Goulding et al. (2003) in defining the Amazon River basin as that portion of the continent of South America which is drained by the Amazon River and its tributaries.

Results

Key to females of Amazon Basin subgenera of *Xylocopa* (Modified from Michener 2007)

1. Lower tooth of mandible narrower than upper tooth, as measured across the mandible at the apex of the notch between upper and lower tooth ***Xylocopa (Stenoxylocopa)* – One species:**
X. (Stenoxylocopa) ruficollis Hurd and Moure, 1963
- Lower tooth of mandible equal to or much wider than upper tooth **2**
- 2(1). Ventral segments of metasoma with a conspicuous, well-defined median longitudinal ridge; ridges of consecutive segments forming a distinct ventral “keel” along midline of metasoma ***Xylocopa (Neoxylocopa)* – 13 species:** see key below
- Ventral segments of metasoma more gently rounded, with at most an indistinct, feeble median longitudinal ridge or with ridge absent ***Xylocopa (Schonherria)* – 10 species:** see key below

Xylocopa (Neoxylocopa) Michener 1954: 155, 157–158

Type species: *Apis brasilianorum* Linnaeus, 1767, by original designation.

Xylocopa (Neoxylocopa) aeneipennis (De Geer 1773: 573)

Fig. 1

Known distribution. Barbados, Brazil (Pará), French Guiana, Guyana, Suriname, Venezuela (Hurd 1978: 46). Type locality: “Surinam” (De Geer 1773: 573).

Notes. This species was recorded from Pará in Brazil by Hurd (1978), but there are no specimens of this species from this state in the USNM collection. I include it in the key below based on material that I examined in USNM from localities in northern South America outside the Amazon basin, including localities in Suriname, Guyana, and French Guiana, as well as Barbados. The female of this species can be readily recognized by the combination of densely, coarsely punctate metasomal tergites and hyaline wings with feeble iridescent reflections.

Xylocopa (Neoxylocopa) amazonica Enderlein 1913: 259–260

Fig. 2

Known distribution. Brazil (Amapá, Amazonas, Ceará, Guapore, Maranhão, Mato Grosso, Pará, Paraíba, Rondônia; Hurd 1978: 46). Type Locality: “Brasilien. Óbidos” (Enderlein 1913: 260).

Material examined. Brazil: Pará: Cachimbo, VI.1955, F. M. Oliveira (1 ♂), XI.1961, M. Alvarenga and F. M. Oliveira (2 ♀), VI.1962, M. Alvarenga and F. M. Oliveira (8 ♀); Conceição do Araguaia, VII.1959, M. Alvarenga (1 ♂); Guama, 8.V.1956, E. Lobato (1 ♀).

Notes. Females of this species are similar to those of *X. (N.) suspecta* Moure and Camargo from southern Brazil, a species which has also been reported from the Amazon basin (Moure and Camargo 1988 and records below). The most obvious difference between females of these two species is in the coloration of the wing iridescence, which is brilliant green in *X. (N.) suspecta* but duller and more greenish-blue, particularly at the base of the wings, in *X. (N.) amazonica*. Females of *X. (N.) suspecta* also have much coarser punctures on the metasomal tergites than females of *X. (N.) amazonica*. *Xylocopa (N.) suspecta* was not described at the time that Hurd (1978) published his annotated catalog, and thus it is possible that some of the records for *X. (N.) amazonica* from southern Brazil in Hurd (1978) may actually refer instead to *X. (N.) suspecta*.

***Xylocopa (Neoxylocopa) aurulenta* (Fabricius 1804: 351)**

Fig. 3

Known distribution. Brazil (Acre, Amapá, Amazonas, Guapore, Minas Gerais, Pará, Rio Branco, Rondônia), Guyana, French Guiana, Peru, Suriname (Hurd 1978: 48). Type locality: “America meridionali” (Fabricius 1804: 351).

Material examined. Brazil: Amazonas: Tapuruquara, X.1954, A. Aguirre (1 ♀), VI.1963, L. Guidani (58 ♀), Tefé, XI.1959 (1 ♀); Pará: Belem, X.1954, O. Rego (1 ♀), X.1955 (1 ♀), 6.X.1954 (1 ♀), XI.1960 (1 ♀), Brancanca, 22.III.1956, M. C. Oliveira (1 ♀), Curusamba, Óbidos, VII.1955, J. Brazilino (1 ♀), 1.VIII.1954, J. Brazilino (1 ♀), Fordlândia, I.1956, R. Damageno (1 ♀), Mosqueiro, 29.VIII.1954, N. Cerqueira (1 ♀).

Notes. This species belongs to a well-defined South American species group whose females have orange pubescence on the mesosoma. Moure (1949) provides a key to several species in this group, which however does not include *X. (N.) aurulenta*. Females of this species can be readily separated from those of the other Amazon basin species in this group by the lack of orange pubescence on the first metasomal tergite.

***Xylocopa (Neoxylocopa) carbonaria* Smith 1854: 358**

Fig. 4

Known Distribution. Brazil (Alagoas, Bahia, Ceará, Maranhão, Mato Grosso, Minas Gerais, Pará, Paraíba, Rio Grande do Norte; Hurd 1978: 53). Type Locality: “Brazil (Tapajos)” (Smith 1854: 358).

Material examined. Brazil: Pará, Cachimbo, VI.1955, F. M. Oliviera (1 ♀), X.1955, M. Alvarenga (1 ♀), VI.1962, M. Alvarenga and F. M. Oliveira (64 ♀), Santarém, VII.1955, M. Silva (1 ♀), IX.1955, M. Alvarenga (5 ♀), X.1955, M. Silva (5 ♀), M. Alvarenga (1 ♀), XI.1955, M. Silva (16 ♀), X.1955, M. Alvarenga (1 ♀), 10.XII.1955, M. Silva (5 ♀), V.1960 (2 ♀).

Notes. The small body size, dense black pubescence on much of the mesonotum and metasomal tergites, and black wings with feeble violet iridescence are diagnostic for females, at least among the species of subgenus *Neoxylocopa* in the Amazon basin.

***Xylocopa (Neoxylocopa) cearensis* Ducke 1910: 85**

Fig. 5

Known Distribution. Brazil (Bahia, Ceará, Goiás, Mato Grosso, Pará, Paraíba, Rio Grande do Norte; Hurd 1978: 54). Also reported here from Amazonas and Rondônia. Type locality: Caridade, Ceará, Brazil (Ducke 1910: 85).

Material examined. Brazil: Amazonas: Tapuruquara, V.1963, L. Guindani (4 ♀), VI.1963, L. Guindani (3 ♀); Pará: Belem, VI.1956, M. C. Oliveira (1 ♀); Conceição do Araguaia, IX.1959, J. S. P. Costa (1 ♀), II.1960, J. S. P. Costa (13 females), Mangabeira, Mocajuba, V.1953, O. Rego (1 ♀); Rondônia: Pedro Velho, 2.XI.1954, Barros (3 ♀).

Notes. The female of this species is superficially similar in overall appearance to that of *X. (N.) grises-cens* Lepeletier but is much smaller in overall body size and total body length, as noted in the key. The date of publication of the paper by Ducke in which this species was described has been given by various authors and databases as 1909, 1910, or 1911 (Hurd and Moure 1963; Hurd 1978). Although the first portion of Volume 28 of the “Revue d’Entomologie” was indeed published in 1909, the indication at the bottom of p. 81 in the middle of the Ducke (1910) paper indicates that the particular issue containing the description of *Xylocopa cearensis* was published in “Mars [= March], 1910.”

***Xylocopa (Neoxylocopa) fimbriata* Fabricius 1804: 340**

Fig. 6

Known Distribution. Barbados, Belize, Brazil (Pará, Rio Branco), Colombia, Costa Rica, Ecuador, El Salvador, French Guiana, Guatemala, Guadeloupe, Guyana, Honduras, Martinique, México, Nicaragua, Panamá, St. Kitts, Suriname, Trinidad, Venezuela (Hurd 1978: 77). Recorded here from Roraima, Brazil. Type locality: “America meridionali” (Fabricius 1804: 340).

Material examined. Brazil: Roraima: Surumu (4 ♀).

Notes. Females of this species can be readily recognized by the unique pair of tubercles or “horns” on the frons, as described in the key. The length and prominence of the two tubercles varies greatly among females in this species, and even varies among specimens which were collected at the same time at the same locality (Hurd 1978; Mawdsley 2017).

***Xylocopa (Neoxylocopa) frontalis* (Olivier 1789: 64)**

Fig. 7

Known distribution. Argentina, Belize, Bolivia, Brazil (Acre, Alagoas, Amapá, Amazonas, Bahia, Ceará, Espírito Santo, Goiás, Guanabara, Maranhão, Mato Grosso, Minas Gerais, Pará, Paraíba, Paraná, Rio de Janeiro, Rio Branco, Rio Grande do Norte, Rio Grande do Sul, Rondônia, Santa Catarina, São Paulo), Colombia, Costa Rica, Ecuador, El Salvador, French Guiana, Guatemala, Guyana, Honduras, México (Chiapas, Veracruz), Nicaragua, Panamá, Paraguay, Peru, Suriname, Trinidad, Uruguay, Venezuela (Hurd 1978: 79-80). Type locality: “Cayenne” (Olivier 1789: 64).

Material examined. Brazil: Pará: Belém (1 male), Óbidos (1 ♀, 1 ♂), Pará (7 ♀, 1 ♂); Rondônia: Porto Velho (1 ♀), Porto Velho-Abunã Road km 65 (1 ♀). Peru: Huánuco: Tingo María (1 ♀). Venezuela: Amazonas, Cerro de la Neblina (1 ♀).

Notes. Females of this species can be readily recognized by the unique transverse carina on the frons which has the median ocellus embedded in the center of the transverse carina. This species is an important pollinator of many tropical plant species (Hurd 1978).

***Xylocopa (Neoxylocopa) grisescens* Lepeletier 1841: 178–179**

Fig. 8

Known distribution. Brazil (Alagoas, Amapá, Bahia, Ceará, Goiás, Maranhão, Mato Grosso, Minas Gerais, Pará, Paraíba, Pernambuco, Piauí, Rio Grande do Norte, São Paulo, Sergipe) and Paraguay (Hurd 1978: 61). Type locality: “Patrie inconnue [unknown locality]” (Lepeletier 1841: 179).

Material examined. Brazil: Pará: Conceição do Araguaia, VII.1959, M. Alvarenga (1 ♀), Santarém, VII.1957, M. Silva (1 ♀), Santarém, IX.1955, M. Alvarenga (1 ♀), X.1955, M. Alvarenga (1 ♀).

Notes. Females of this species can be easily separated from all other species of subgenus *Neoxylocopa* by the combination of yellow pubescence on the mesosoma and the massive body size, with overall body length in the specimens examined between 21.8 and 29.6 mm. In the Amazon basin, *X. (N.) cearensis* is the only species whose females are similar in coloration to those of *X. (N.) grisescens*, but females of *X. (N.) cearensis* are much smaller, with overall body length between 16.4 and 17.6 mm.

***Xylocopa (Neoxylocopa) hirsutissima* Maidl 1912: 315**

Fig. 9

Known distribution. Bolivia, Brazil (Goiás, Guanabara, Mato Grosso, Minas Gerais, Pará, Paraná, Piauí, Rio de Janeiro, Rondônia, São Paulo), Paraguay (Hurd 1978: 62). Type locality: “Paraguay (San Luis)” (Maidl 1912: 315).

Material examined. Brazil: Pará: Cachimbo, VI.1962, M. Alvarenga and F. M. Oliveira (1 ♀); Palmeiras, 8.X.1959, P. D. Hurd (1 ♂); Bahia: Nilo Peçanha, X.1955, A. A. Sousa (1 ♀); Rondônia: Vilhena, XI.1960, M. Alvarenga leg. (1 ♀).

Notes. Females of this species can be readily recognized by the dense black pubescence over much of the mesonotal disc and the metasomal tergites, dark wings with violet iridescence, and overall body size which is larger (20.5 to 23.0 mm in overall body length in the material examined) than the similar *X. (N.) carbonaria* (which has overall body length of 17.0 to 18.6 mm).

***Xylocopa (Neoxylocopa) orthogonaspis* Moure 2003: 71–73**

Fig. 10

Known distribution. Brazil (Amazonas, Pará), Colombia (Moure 2003: 71). Type locality: “Manaus, AM-BRASIL” (Moure 2003: 72).

Material examined. Brazil: Amazonas: Manaus, VIII.1959 (5 ♀), IX.1959 (2 ♀), X.1959, C. Elias (14 ♀), XI.1959, C. Elias (4 ♀); Pará: Santarém, VIII.1919, E. M. Klages (1 ♀), VI.1955, M. Silva (8 ♀), IX.1955, M. Alvarenga (1 ♀), X.1955, M. Silva (25 ♀), Santarém, Ulumari, 15.IX.1955, M. O. Silva (3 ♀).

Notes. Specimens of this species in USNM were tentatively identified by Paul D. Hurd as *X. (N.) brasilianorum* (Linnaeus), a similarly-colored species which is otherwise known from localities in southern Brazil which are outside the Amazon basin (Hurd 1978; Moure 2003). The brief discussion and reports of *X. (N.) submordax* Cockerell from the Amazon basin by Moure and Camargo (1988) refer instead to this species (Moure 2003). The true *X. (N.) submordax* was placed in synonymy with *X. (N.) transitoria* Pérez by Moure (2003); specimens of this latter species in USNM all have greenish-blue or bluish-violet wing iridescence and are from localities in northern South America and the Caribbean which are located outside the Amazon basin.

***Xylocopa (Neoxylocopa) similis* Smith 1874: 291**

Fig. 11

Known distribution. Brazil (Amazonas, Pará), Colombia, Ecuador, Peru (Hurd 1978: 68). Type locality: “Para” (Smith 1874: 291).

Material examined. Brazil: Amazonas: Benjamin Constant, VIII.1956, I. C. Lima (2 ♀), IX.1956, I. C. Lima (2 ♀), Manaus, VIII.1959, Ellas (1 female), Tabatinga, X.1958, F. M. Oliveira (1 ♀), III.1959, F. M. Oliveira (2 ♀, 1 ♂), Tefé, VIII.1959, R. Carvalho (1 ♀), XI.1959, R. Carvalho (6 ♀), XII.1959, R. Carvalho (6 ♀), 1-4.XII.1961, F. M. Oliveira (2 ♀); Pará: Óbidos, V.1956, F. M. Oliveira (1 ♀).

Notes. Females of this species are similar to those of *X. (N.) aurulenta* but can be readily distinguished by the presence of orange pubescence on the first metasomal tergite, as described in the key.

***Xylocopa (Neoxylocopa) suspecta* Moure and Camargo 1988: 209–214**

Fig. 12

Known distribution. Bolivia, Brazil (Bahia, Espírito Santo, Mato Grosso, Minas Gerais, Pará, Paraíba, Pernambuco, Rio Grande do Sul, Rio de Janeiro, São Paulo; Moure and Camargo 1988: 211–214; Moure 2012). Type locality: “Ribeirão Preto SP” (Moure and Camargo 1988: 211).

Material examined. Brazil: Pará: Conceição do Araguaia, VII.1959, M. Alvarenga (1 ♀), Santarém, IX.1955, M. Alvarenga (1 ♀); Rondônia: Abunã, XI.1962, W. Bokerman (1 ♀).

Notes. According to Moure and Camargo (1988), this is a very common species in southeastern Brazil and the female of this species can be easily separated from females of most of the sympatric species

of subgenus *Neoxylocopa* by its brilliant green wing iridescence. In describing this species, Moure and Camargo did not compare it to *X. (N.) amazonica*, a similar species whose distribution overlaps in part with that of *X. (N.) suspecta*. In the material that I examined, the wing iridescence of females of *X. (N.) amazonica* is much less brilliant, and is distinctly bluish-green, particularly towards the base of the wing. The female of *X. (N.) suspecta* also has much larger and denser punctures on the tergites of the metasoma. These two species belong to a well-defined group of large-bodied species of subgenus *Neoxylocopa* with greenish iridescence on the wings. Another valid species in this group is *X. (N.) nasica* Pérez, which has greenish-golden wing iridescence and is known from northern Colombia, Panamá, and Costa Rica (Hurd 1978; Mawdsley 2017).

***Xylocopa (Neoxylocopa) tegulata* Friese 1911: 686**

Fig. 13

Known distribution. Bolivia, Brazil (Mato Grosso), Peru (Hurd 1978: 73). Type locality: “Tarata (Bolivien)” (Friese 1911: 686).

Material examined. Peru: Tingo Maria, 670 m, X.1947, Weyrauch (2 ♀).

Notes. Females of this species can be readily recognized by the lighter pigmentation of the tegulae, which varies from reddish-orange to reddish-brown in the material examined and contrasts with the otherwise black pigmentation of the mesosoma.

Key to females of species of *Xylocopa (Neoxylocopa)* recorded from the Amazon River basin of South America

1. Frons with a stout central tubercle immediately adjacent to ocelli, or with two horn-like projections immediately adjacent to ocelli **2**
- Frons flat adjacent to ocelli **3**
- 2(1). Frons with a stout central tubercle; the median ocellus bisecting the front of the tubercle ***X. (N.) frontalis* (Olivier)**
- Frons with a transverse ridge ending on either side in a more or less distinct horn-like projection immediately adjacent to the lateral ocelli; median ocellus located well below carina on flat portion of frons ***X. (N.) fimbriata* Fabricius**
- 3(1). Mesosomal pubescence yellow, orange, or reddish-orange **4**
- Mesosomal pubescence black or dark brownish-black **7**
- 4(3). Mesosomal pubescence bright yellow **5**
- Mesosomal pubescence orange or reddish-orange **6**
- 5(4). Body massive, overall body length 21.8 to 29.6 mm ***X. (N.) grisescens* Lepelletier**
- Body smaller, overall body length 16.4 to 17.6 mm ***X. (N.) cearensis* Ducke**
- 6(4). Pubescence of first metasomal tergite orange, at least in part ***X. (N.) similis* Smith**
- Pubescence of first metasomal tergite entirely black ***X. (N.) aurulenta* (Fabricius)**
- 7(3). Wing pigmentation clear; wing surface sometimes with metallic iridescence **8**
- Wings pigmentation dark brownish-black; wing surface often with metallic iridescence **9**
- 8(7). Wings with very faint, feeble iridescence; scutellum broadly rounded and lacking a transverse ridge ***X. (N.) aeneipennis* (De Geer)**
- Wings with strong, brilliant gold-coppery iridescence; scutellum medially with a broad, sharply angled transverse ridge ***X. (N.) orthogonaspis* Moure**
- 9(7). Wings with greenish-blue, golden-green, or green iridescence **10**
- Wings with violet iridescence **11**

- 10(9). Wings with uniform brilliant green or golden-green iridescence **X. (N.) *suspecta* Moure and Camargo**
 — Wings with dull greenish-blue iridescence; iridescence bluer towards base of wing and becoming somewhat brighter greenish towards apices of wings . . . **X. (N.) *amazonica* Enderlein**
- 11(9). Mesonotum clothed in black pubescence except for a median triangular smooth and glossy area; tegulae black **12**
 — Mesonotum almost entirely glabrous and glossy, with limited amounts of black pubescence; tegulae orange or reddish-brown **X. (N.) *tegulata* Friese**
- 12(11). Overall body size larger, body length 20.5 to 23.0 mm **X. (N.) *hirsutissima* Maidl**
 — Overall body size smaller, body length 17.0 to 18.6 mm **X. (N.) *carbonaria* Smith**

Xylocopa (Schonnherria) Lepeletier 1841: 207

Type species: *Xylocopa micans* Lepeletier, 1841, by subsequent designation of Sandhouse (1943: 598).

***Xylocopa (Schonnherria) dimidiata* Latreille 1809: 95**

Fig. 14

Known distribution. Argentina, Brazil (Amazonas, Mato Grosso, Pará, São Paulo), Bolivia, Paraguay, Peru (Hurd 1978: 17). Type locality: not stated in original description (Latreille 1809: 95).

Notes. This species was recorded by Hurd (1978) from the Brazilian states of Amazonas and Pará but there are no specimens from either state in USNM. The characters in the key are taken from specimens collected at localities from Bolivia and Peru outside the Amazon River basin. The combination of metallic blue dorsal coloration and black pubescence on the metasoma appears to be diagnostic for the female of this species, at least among the Amazon Basin species of subgenus *Schonnherria*.

***Xylocopa (Schonnherria) lucida* Smith 1874: 290**

Fig. 15

Known distribution. Brazil (Acre, Amapá, Amazonas, Guapore, Mato Grosso, Minas Gerais, Pará, Rondônia), Bolivia, Colombia, French Guiana, Peru, Venezuela (Hurd 1978: 19). Type locality: “Pará” (Smith 1874: 290).

Material examined. Bolivia: Beni, Guayaramerín, 13.X.1934, W. Forster (1 ♀), Rurrenabaque, Rio Beni, W. M. Mann, Mulford Biological Expedition (1 ♀); Chapare, Rio Chipiriri, 400 m, 27.X.1953, W. Forster (1 ♀), 28.X.1953 (2 ♀). Brazil: Pará: Cachimbo, IX.1954, M. Alvarenga (1 ♀), Óbidos, I.1956, F. M. Oliveira (1 ♀). Peru: Tingo Maria, Rio Huallaga, 700 m, 4.I.1940, Weyrauch (1 ♀).

Notes. Females of this species can be separated from those of the similar small-bodied species *X. (S.) muscaria* (Fabricius) by the black (as opposed to white) setae on the gena.

***Xylocopa (Schonnherria) macrops* Lepeletier 1841: 209–210**

Fig. 16

Known distribution. Argentina, Bolivia, Brazil (Amazonas, Ceará, Espírito Santo, Goiás, Guanabara, Guapore, Mato Grosso, Minas Gerais, Pará, Paraná, Rio de Janeiro, Rio Grande do Sul, Santa Catarina, São Paulo), Colombia, Paraguay, Peru. Type locality: “Brésil” (Lepeletier 1841: 210).

Material examined. Brazil: Amazonas: Tefé, XII.1959 (1 ♀); Pará: Cachimbo, IX.1954, M. Alvarenga (3 ♀), VII.1955, J. A. Araujo (1 ♂), VI.1962, M. Alvarenga and F. Oliveira (75 ♀), Conceição do Araguaia, II.1960, J. S. P. Costa (13 ♀, 2 ♂).

Notes. The matte black coloration and lack of iridescence on the wing apices, combined with the black metasomal coloration, will separate females of this species from the two other large-bodied species of subgenus *Schonnherria* in the Amazon basin, as noted in the key.

***Xylocopa (Schonnherria) metallica* Smith 1874: 292**

Fig. 17

Known distribution. Brazil (Amazonas, Pará), Colombia, Suriname, Peru. Type locality: “Para” (Smith 1874: 292).

Material examined. Brazil: Amazonas: Rio Uaupés, 1906, H. Schmidt (1 ♀).

Notes. Females of this species are easily recognized by the presence of orange pubescence on metasomal tergites 3-6, combined with the presence of black pubescence on metasomal tergites 1–2.

***Xylocopa (Schonnherria) muscaria* (Fabricius 1775: 386)**

Fig. 18

Known distribution. Bolivia, Brazil (Alagoas, Amapá, Amazonas, Bahia, Ceará, Espírito Santo, Goiás, Guanabara, Guapore, Maranhão, Mato Grosso, Pará, Paraíba, Paraná, Rio de Janeiro, Rio Grande do Norte, Rondônia, São Paulo), Colombia, Costa Rica, Curacao, El Salvador, French Guiana, Guatemala, Guyana, Honduras, México, Panamá, Paraguay, Peru, Suriname, Trinidad, Venezuela (Hurd 1978: 21). Type locality: not indicated in original description, but Hurd and Moure (1963: 310) indicate that it was “almost certainly from the surroundings of Rio de Janeiro, Brazil.”

Material examined. Bolivia: Beni, Rurrenabaque, 175 m, 17.X.1908, L. Pena (1 ♀), 1921–1922, Mulford Biological Expedition (1 ♀). Brazil: Amazonas: Benjamin Constant, IX.1955, I. C. Lima (1 ♀), Colonia Rio Branco, Óbidos, IV.1953, J. Brazilino (1 ♀), Manaus, Mann and Baker (1 ♀), V.1959, C. Ellas (2 ♀), VI.1959, C. Ellas (1 ♀), Tapuruquara, Uaupés, X.1954, A. Guirre (1 ♀), Tefé, XI.1959, R. Carvalho (6 ♀), XI.1960, R. Carvalho (1 ♀), 8.XII.1961, F. M. Oliveira (1 ♀); Amapá: Fazendinha, Macapa, VIII.1961, L. Silva (4 ♀), Oiapoque, V.1953, M. Alvarenga (3 ♀), VI.1959, C. Seabra (1 ♀); Pará: Belem, 13.V.1956, E. Lobato (1 ♀), 15.X.1964, W. D. Bennett, ex *Solanum* L. sp. (Solanaceae) (1 ♀), Belterra, Santarém, V.1960, M. Alvarenga (7 ♀), F. M. Oliveira (1 female), Cachimbo, VI.1962, M. Alvarenga and F. M. Oliveira (11 ♀, 2 ♂), Conceição do Araguaia, VII.1959, M. Alvarenga (2 ♀), Mangabeira, Mocajuba, VI.1953, O. Rego (2 ♀), Óbidos, V. 1959, F. M. Oliveira (1 ♀), VI.1956, J. Brazilino (1 ♀), XI.1950, J. Brazilino (1 ♀), XI.1954, F. M. Oliveira (1 ♀); Santarém, V.1950, F. M. Oliveira (20 ♀), IX.1955, M. Alvarenga (7 ♀), X.1955, M. Silva (2 ♀), M. Alvarenga (6 ♀), XI.1955, M. Silva (4 ♀), M. Alvarenga (12 ♀, 2 ♂).

Notes. The female of this small-bodied species is easily recognized by the dense white pubescence on the gena.

***Xylocopa (Schonnherria) ornata* Smith 1874: 290**

Fig. 19

Known distribution. Bolivia, Brazil (“Amazon Basin”), Colombia, Peru, Venezuela (Hurd 1978: 23). Type locality: “St. Paulo” (Smith 1874: 290).

Material examined. Bolivia: Beni, Rurrenabaque, XI.1921, W. M. Mann, Mulford Biological Expedition (1 ♀). Brazil: Amazonas: Benjamin Constant, IX.1955, I. C. Lima (2 ♀), Manaus, X.1959, C. Ellas (1 ♂), Rio Uaupés, 1906, H. Schmidt (2 ♀); Tapuruquara, Uaupés, X.1954, A. Aguirre (1 ♀), Tefé, IX.1960, R. Carvalho (4 ♀), X.1960 (1 ♀), XI.1960 (6 ♀); Pará: Jacareacanga, X.1959, M. Alvarenga (4 ♀); Óbidos, 20.VIII.1955, J. Brasilino (1 ♀), XII.1955, F. M. Oliveira (1 ♀); Rondônia: Pimenta Bueno, XI.1960, M. Alvarenga (1 ♀). Peru: Moncon Valley, Tingo Maria, 10.XI.1954, E. I. Schlinger and E. S. Ross (1 ♀); Palcazu, Rosenberg (1 ♀).

Notes. Female easily recognized by the green dorsal iridescence and the presence of orange pubescence on metasomal tergites 1–6.

***Xylocopa (Schonnherria) simillima* Smith 1854: 357–358**

Fig. 20

Known distribution. Argentina, Bolivia, Brazil (Acre, Amazonas, Minas Gerais, Pará, Santa Catarina, São Paulo), Paraguay, Peru (Hurd 1978: 23). Type locality: “Australia” (Smith 1854: 358), which Hurd and Moure (1963: 315) indicate was almost certainly in error for South America.

Material examined. Brazil: Amazonas: Tapuruquara, VI.1961, L. Guindani (1 ♀), Tefé, VI.1957, R. Carvalho (1 ♀), XI.1959, R. Carvalho (5 ♀), XII.1959, R. Carvalho (1 ♀), 1-4.XII.1961, F. M. Oliveira (1 ♀), 8.XII.1961, F. M. Oliveira (1 ♀); Pará: Belem, VI.1946, M. Alvarenga (1 ♀), VII.1960, F. Oliveira (1 ♀), Mangabeira, Mocajuba, IV.1953, O. Rego (4 ♀), Óbidos, VIII.1957, F. M. Oliveira (2 ♀), XII.1955, F. M. Oliveira (1 ♀); Santarém, IX.1955, M. Alvarenga (22 ♀), XI.1955, M. Alvarenga (6 ♀), Santarém, Ulumari, 15.IX.1955, M. G. Silva (12 ♀); Rondônia: Abunã, XI.1962, W. Bokerman (8 ♀), Forte Principe da Beira, XI.1961, F. M. Oliveira (1 ♀), Vilhena, XI.1960, M. Alvarenga (2 ♀).

Notes. Smith (1854: 357–358) based his original description of this species on female specimens in which the metasomal tergites of the female have distinct orange-pigmented transverse bands. However, in a majority of the female specimens that I examined, the metasomal tergites are entirely black. This color variation (entirely black metasomal tergites versus black tergites with orange transverse bands) is similar to the color variation displayed by various populations of the widespread *X. (N.) frontalis* (Hurd 1978: 80–81) and also by *X. (N.) nigrocincta* Smith which occurs in Argentina, Paraguay, and southern Brazil. The female of *X. (S.) simillima* superficially resembles females of some of the sympatric species of subgenus *Neoxylocopa* but can be separated from the species of that subgenus by the lack of the central longitudinal carina on the metasomal sternites.

***Xylocopa (Schonnherria) subcyanea* Pérez 1901: 74–75**

Fig. 21

Known distribution. Argentina, Bolivia, Brazil (Alagoas, Bahia, Espírito Santo, Goiás, Mato Grosso, Minas Gerais, Pará, Paraná, São Paulo), Paraguay, Uruguay (Hurd 1978: 25). Type locality: “Brésil (Province de Matto-Grosso)” (Pérez 1901: 75)

Material examined. Brazil: Pará: Cachimbo, VI.1962, M. Alvarenga and F. M. Oliveira (5 ♂); Conceição do Araguaia, II.1960, J. S. P. Costa (3 ♀, 4 males), VII.1959, M. Alvarenga (7 ♂), Óbidos, IX.1959, F. M. Oliveira (2 ♀, 1 ♂).

Notes. The female of this small-bodied species can be readily separated from the other small-bodied species of subgenus *Schonnherria* in the Amazon basin by the hyaline (as opposed to darkly pigmented) wings,

***Xylocopa (Schonnherria) varians* Smith 1874: 291–292**

Fig. 22

Known distribution. Argentina, Bolivia, Brazil (Amazonas, Espírito Santo, Guanabara, Guapore, Mato Grosso, Paraíba, Paraná, Rio de Janeiro, Rio Grande do Sul, Santa Catarina, São Paulo), Colombia, Ecuador, Panamá, Paraguay (Hurd 1978: 26–27; includes multiple named infrasubspecific varieties). Type locality: “South Brazil” (Smith 1874: 292).

Material examined. Ecuador: Rio Yacuambi (1 ♀).

Notes. This specimen was identified and labeled by P. Hurd as *X. (S.) varians* var. *piurensis* Cockerell (1912: 492), a form originally described from material collected at Piura in northwestern Peru outside the Amazon basin. Additional manuscript notes from Hurd accompanying the specimens of this species in the USNM collection indicate that Hurd viewed *X. (S.) varians* as a species complex that may involve

multiple species-level taxa. A more comprehensive revisionary treatment of this group is outside the scope of the present paper. From the other Amazon basin species of subgenus *Schonnherria*, females of *X. (S.) varians* can be identified by the combination of dark dorsal pubescence, blue dorsal iridescence, and white lateral setae on the metatarsi.

Xylocopa (Schonnherria) viridis Smith 1854: 360

Fig. 23

Known distribution. Argentina, Bolivia, Brazil (Amazonas, Ceará, Guapore, Maranhão, Mato Grosso, Minas Gerais, Pará, Santa Catarina), Colombia, Costa Rica, French Guiana, Guatemala, Guyana, México, Panamá, Paraguay, Peru, Suriname (Hurd 1978: 28). Type locality: “Brazil (Rio Tapajos)” (Smith 1854: 360).

Material examined. Bolivia: Beni, Rurrenabaque, W. M. Mann, 1921-1922, Mulford Biological Expedition (1 ♂), 175 meters, 5.X.1956, L. Pena (1 ♂). Brazil: Amazonas: Manaus, X.1959, C. Ellas (1 ♂), XI.1959, C. Ellas (2 ♂), Tefé, I.1962, B. Carvalho (1 ♂); Pará: Colônia Rio Branco, Óbidos, X.1959, J. Brazilino (1 ♂), F. M. Oliveira (1 ♂), Óbidos, 1962, F. M. Oliveira (1 ♂). Peru: Puerto Maldonado, Madre de Dios, 3.IX.1962 (1 ♂); Tingo Maria, Huanuco, 2200 feet, 26.V.1947 (1 ♂).

Notes. The presence of pale yellowish-brown pubescence on the mesosoma will separate females of this species from the other Amazon basin species of subgenus *Schonnherria*, which generally have dark brownish-black to black mesosomal pubescence.

Key to females of species of *Xylocopa (Schonnherria)* recorded from the Amazon River basin of South America

1. Dorsal surface of metasomal tergites 4, 5, and 6 covered in uniform orange pubescence 2
- Dorsal surface of metasomal tergites 4, 5, and 6 either smooth or with black pubescence laterally 3
- 2(1). Lateral fringe of pubescence on metatarsi black; pubescence on metasomal tergites 1–2 black *X. (S.) metallica* Smith
- Lateral fringe of pubescence on metatarsi bright yellow or orange; pubescence on metasomal tergites 1–2 orange *X. (S.) ornata* Smith
- 3(1). Lateral pubescence of metatarsi white, yellowish or orange 4
- Lateral pubescence of metatarsi dark brownish-black to black 5
- 4(3). Mesosomal pubescence pale yellowish-brown *X. (S.) viridis* Smith
- Mesosomal pubescence black *X. (S.) varians* Smith
- 5(3). Fifth metasomal tergite with white pubescence along lateral margin 6
- Marginal pubescence of fifth metasomal tergite black 7
- 6(5). Gena with dense white pubescence *X. (S.) muscaria* (Fabricius)
- Gena with scattered black setae *X. (S.) lucida* Smith
- 7(5). Body size smaller, total body length 15.0 to 16.3 mm *X. (S.) subcyanea* Pérez
- Body size larger, total body length 20.5 to 24.6 mm 8
- 8(7). Metasomal tergites metallic blue *X. (S.) dimidiata* Latreille
- Metasomal tergites dark brownish-black to black, sometimes with transverse orange pigmented bands 9
- 9(8). Wing surface with violet iridescence basally, matte black apically
- Wing surface with some violet iridescence basally, otherwise with greenish-blue iridescence *X. (S.) macrops* Lapeletier
- *X. (S.) simillima* Smith

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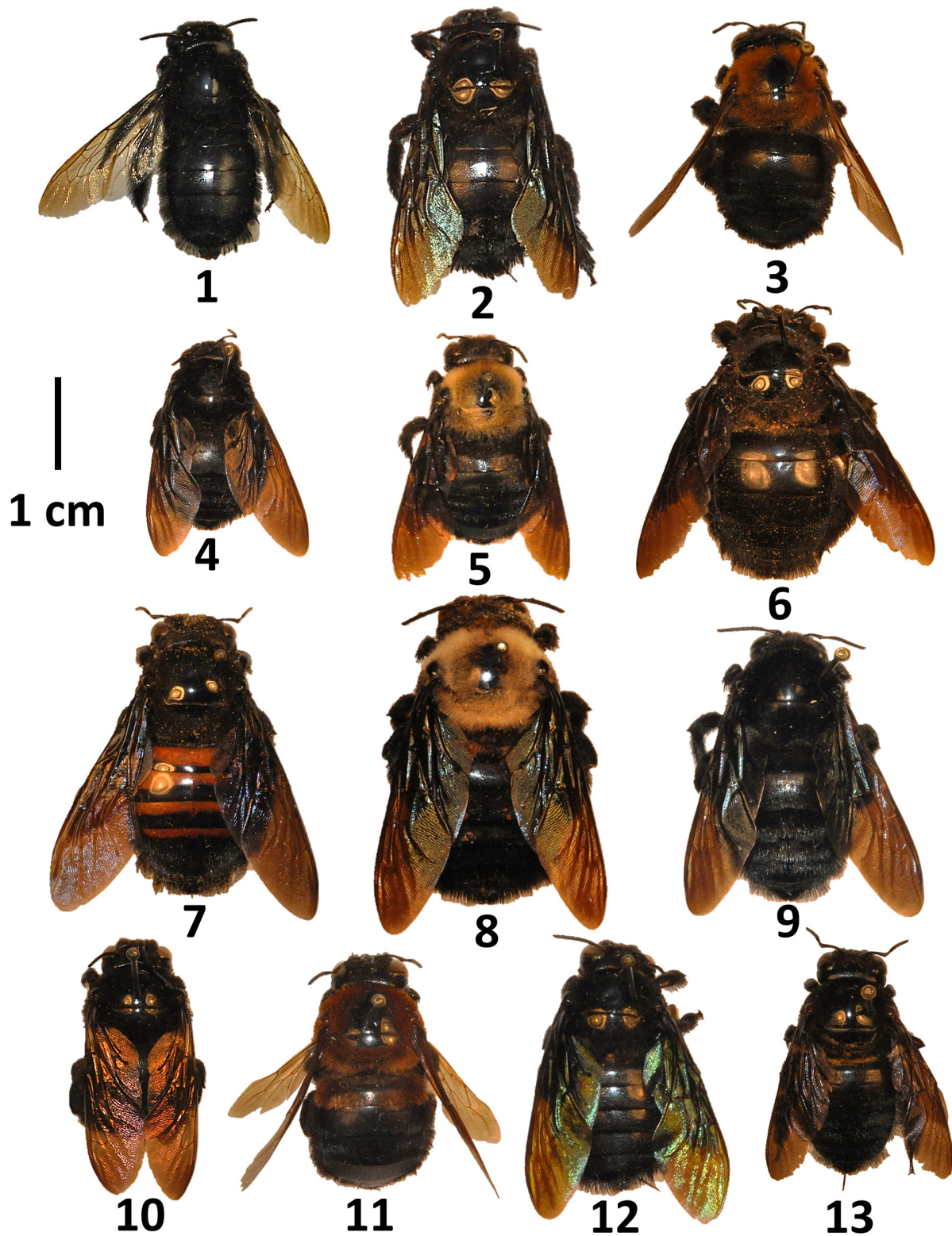
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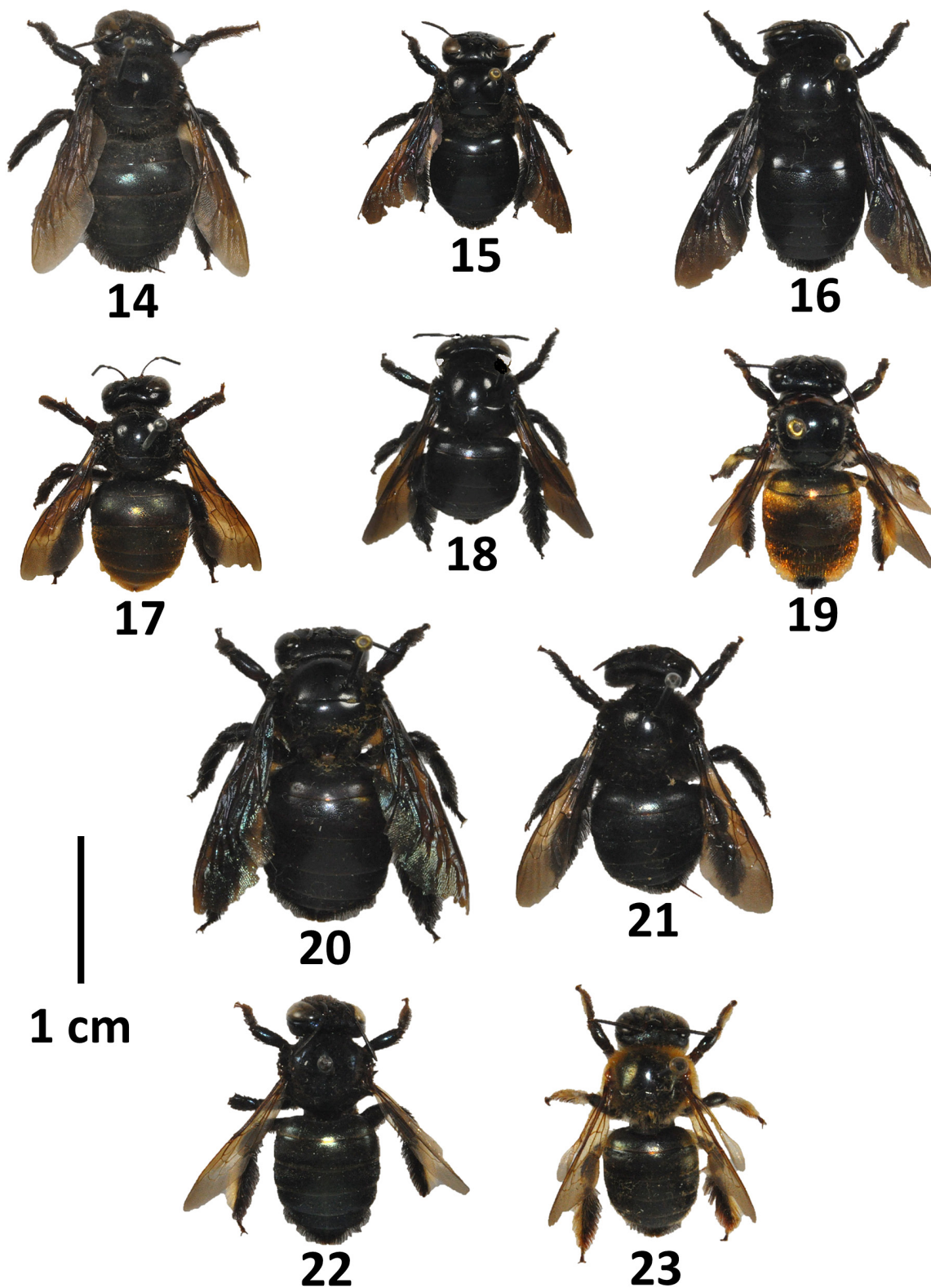
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Figures 1–13. Dorsal habitus photographs of pinned, preserved specimens of females of *Xylocopa* (*Neoxylocopa*) species from the Amazon River basin, from the USNM collection. 1) *X. (N.) aeneipennis*. 2) *X. (N.) amazonica*. 3) *X. (N.) aurulenta*. 4) *X. (N.) carbonaria*. 5) *X. (N.) cearensis*. 6) *X. (N.) fimbriata*. 7) *X. (N.) frontalis*. 8) *X. (N.) grisescens*. 9) *X. (N.) hirsutissima*. 10) *X. (N.) orthogonaspis*. 11) *X. (N.) similis*. 12) *X. (N.) suspecta*. 13) *X. (N.) tegulata*.



Figures 14–23. Dorsal habitus photographs of pinned, preserved specimens of females of *Xylocopa* (*Schonnherria*) species from the Amazon River basin, from the USNM collection. 14) *X. (S.) dimidiata*. 15) *X. (S.) lucida*. 16) *X. (S.) macrops*. 17) *X. (S.) metallica*. 18) *X. (S.) muscaria*. 19) *X. (S.) ornata*. 20) *X. (S.) simillima*. 21) *X. (S.) subcyanea*. 22) *X. (S.) varians*. 23) *X. (S.) viridis*.

