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A new stingless bee species of the genus *Nogueirapis* from Costa Rica (Hymenoptera: Apidae)

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Abstract. A new stingless bee species of the genus *Nogueirapis* Moure (Apinae: Meliponini) is described and figured. *Nogueirapis costaricana* Ayala & Engel, new species, is distinguished from its congeners, particularly *N. mirandula* (Cockerell), a species also known from the Pacific forests of Costa Rica. A key to the species of *Nogueirapis*, based on the worker caste, is provided.

INTRODUCTION

The stingless bees of Costa Rica represent a relatively well known fauna (*e.g.*, Wille & Michener, 1973; Griswold *et al.*, 1995, 2006), in no small part due to the efforts of Alvaro Wille (1928–2006) who was particularly focused on the biology and systematics of Meliponini and spent his career researching the regional fauna, among many other fields of scientific inquiry (Monge-Nájera, 2006; Michener, 2007a). Nonetheless, new species continue to be recovered from this area and highlight how ongoing studies into the melittofauna are needed even in seemingly intensively worked regions such as Costa Rica. It is from the discovery and description of new species that we continually refine our understanding of patterns of variation, relationships, and biogeography, and test long-ignored concepts of species (Grimaldi & Engel, 2007; Engel, 2011; Gonzalez *et al.*, 2013).

During recent work in the extensive collections of the Instituto Nacional de Biodiversidad (Santo Domingo de Heredia, Costa Rica), the authors discovered specimens

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of the stingless bee genus *Nogueirapis* Moure that clearly belonged to a species distinct from those previously known. *Nogueirapis* may somewhat resemble species of *Plebeia* Schwarz, but in the former the inner surface of the metatibia has a narrow, bare, shiny, but distinctly not depressed upper margin, whereas this same surface is clearly depressed in the latter. In addition, the corbicula is distinctly larger than that of species of *Plebeia*, with one or two very large bristles arising from its surface (as in the genus *Partamona* Schwarz), and the frons and mesoscutum is almost devoid of the relatively long setae so noticeable in *Plebeia*. *Nogueirapis* differs from *Partamona* in the less expansively developed corbicula (large and spoon-shaped in species of *Partamona*), the presence of abundant yellow markings, the few and mostly curved (not sinuous) large setae of the labial palpi (as is found in various species of *Plebeia s.str.*), the shining and asetose basal area of the propodeum, and the generally small body size (Wille, 1964, 1979).

The genus is not diverse, with only three previously described species, and only one of those has hitherto been documented from Costa Rica (Camargo & Pedro, 2007). Wille (1959, 1962) described a species in Early Miocene amber from Mexico, *Nogueirapis silacea* (Wille), one of only two bee species formally described from the deposits of Chiapas, Mexico (Engel & Michener, 2013; Engel, 2014), but it has subsequently been transferred to *Proplebeia* Michener (Camargo & Pedro, 2007). However, the identity and relationships of *P. silacea* require clarification (Ayala *et al.*, 2013; Engel & Michener, 2013; Strelow *et al.*, in prep.), and indeed much of the fauna of Mexican amber remains to be thoroughly described and their relationships elucidated (Engel, 2004; Solórzano-Kraemer, 2007).

As in other stingless bees, such as *Paratrigona* Schwarz and *Plebeia*, species of *Nogueirapis* are recognized primarily by differences in the color pattern of the worker caste. Such color differences are often supported by other morphological traits including body size as well as the shape and proportions of different structures. *Nogueirapis mirandula* (Cockerell) is perhaps the best characterized and thoroughly studied of all of the species, thanks to the efforts of Wille (Wille, 1962, 1964, 1966). This species occurs in two distinctive forms, a melanic and more typical ferruginous form, and both may occur within a single nest (Wille, 1964). The new material clearly does not fall within the well documented ranges of variation observed in *N. mirandula* and so we provide a description of the species here in an attempt to draw it to the attention of meliponine researchers within the region and to encourage others to seek its nests and additional material from which to test our hypothesis of species within the group.

MATERIAL AND METHODS

Morphological terminology follows that of Engel (2001) and Michener (2007b), with the abbreviations S and T used for metasomal sternum and tergum, respectively. Measurements were taken using an ocular micrometer on an Olympus SZX-12 stereomicroscope. Photomicrographs were prepared using a Nikon D1x digital camera attached to an Infinity K-2 long-distance microscope objective lens. The new material was compared with the other three species of *Nogueirapis* as preserved in the collections of the Instituto Nacional de Biodiversidad, Costa Rica, and the Division of Entomology, University of Kansas Natural History Museum, Lawrence, Kansas, USA, as well as past descriptions and figures provided by Wille (1962, 1964) and Moure & Camargo (1982).



Figures 1–3. Holotype worker of *Nogueirapis costaricana*, new species. 1. Lateral habitus. 2. Dorsal habitus. 3. Detail of metatibia.

SYSTEMATICS

Genus *Nogueirapis* Moure

Nogueirapis costaricana Ayala & Engel, new species

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(Figs. 1–4, 8)

DIAGNOSIS: The new species is similar in appearance to the ferruginous form of *N. mirandula* but with the dark areas of the face more extensively developed and not com-



Figures 4–6. Facial aspects of workers of *Nogueirapis costaricana*, new species, and the melanic and ferruginous forms of *N. mirandula* (Cockerell). 4. *N. costaricana*, holotype. 5. *N. mirandula*, melanic form. 6. *N. mirandula*, ferruginous form.

pletely divided to the median ocellus by a narrow line of yellow integument (cf. Figs. 4, 5), and the broad yellow areas of the face bordering the compound eyes which are medially divided by narrow extensions of dark integument that extend nearly to the epistomal sulcus outside the anterior tentorial pit (Fig. 4). In addition the following combination of traits further supports the recognition of this species: clypeus centrally with large dark area, darker area continuing to clypeal margins as lighter brown, apically with short median line of yellow; yellow bordering compound eye terminating slightly before upper tangent of compound eyes (Figs. 1, 4); scape dark brown with yellow at extreme base and in narrow line on outer ventral surface (Fig. 4); mesepisternum with large dark area on upper half; metatibia, metabasitarsus, and remaining tarsomeres dark brown; metasomal terga yellowish ferruginous narrow transverse bands of brown to light brown. In addition to the pattern of facial maculation (cf. Figs. 4, 6), the new species may also readily be distinguished from the ferruginous form of *N. mirandula* by the latter's entirely yellow ferruginous mesepisternum, anterior legs largely



Figures 7–8. Forewings of workers of *Nogueirapis* Moure from Costa Rica. 7. *Nogueirapis mirandula* (Cockerell), melanic form. 8. *N. costaricana*, new species.

yellow ferruginous, largely yellow ferruginous metatibia with a patch of dark brown in apical half posteriorly and third to one-fifth anteriorly, and yellowish ferruginous metasomal terga with broad transverse bands of dark brown.

DESCRIPTION: ♀: Total body length 4.70 mm; forewing length 4.52 mm. Integument shiny, faintly and finely imbricate, and micropunctate at setal bases. Head slightly wider than long, width 1.83 mm, length 1.51 mm. Integument largely yellow ferruginous except as noted below. Mandible yellow, with distal margin dark brown, condyles nearly black, lower margin with scattered long, reddish brown setae. Labrum yellow, with black setal insertions prominent, setae as long as or slightly shorter than diameter of scape. Malar area narrow, black. Clypeus apically yellow, centrally with large dark area (Fig. 4), darker area continuing to clypeal margins as lighter brown, apically with short median line of yellow, clypeus bordering epistomal sulcus at bend beyond anterior tentorial pit yellow, clypeus slightly more prominent medially, with scattered short suberect setae, upper margin of clypeus slightly concave (Fig. 4); supra-clypeal area slightly elevated, narrowing toward frontal line, largely yellow except brown medially bordering clypeus (Fig. 4) and near antennal toruli, area above supra-clypeal area brown. Scape dark brown, except yellow at extreme base and in narrow line on outer ventral surface; pedicel dark brown; flagellomeres dark brown dorsally, lighter ventrally particularly toward apex (Fig. 4). Face above level of antennae, frons,

and vertex with large area of dark brown to black integument, dark brown area laterally extends ventrally on face below level of antennae and close to epistomal sulcus and tentorial pit, demarcating a narrow yellow area along border of compound eye (Fig. 4), dark area of upper frons not completely divided medially by narrow strip of yellow integument, only divided in lower portion and well distant from median ocellus (Fig. 4), yellow paraocular border terminating slightly before upper tangent of compound eyes (Fig. 4); face with pale micropubescence, such setae not dense, some longest fuscous setae on supraclypeal area and in upper paraocular area. Ocelli positioned above upper tangent of compound eyes (Fig. 4), distance between median and lateral ocelli slightly shorter than diameter of median ocellus (median ocellar diameter 0.10 mm), posterior interocellar distance 1.5x diameter of lateral ocellus, ocellular distance 1.3x diameter of median ocellus, posterior interocellar distance 1.4x ocellular distance. Vertex black, with fuscous setae, such setae as long as or slightly longer than ocellular distance. Yellow strip along posterior border of compound eye in apical two-thirds, remainder of border on gena dark brown and extending to meet dark brown and black of vertex, remainder of gena ferruginous to yellow ferruginous, with pale micropubescence; postgena yellow.

Pronotum yellow, slightly darker dorsally, pronotal lobe yellow with small dark patches anterior to lobe; mesoscutum black, with lateral borders narrowly yellow, yellow not reaching anterolateral angles (Fig. 2), with pale micropubescence and some longer fuscous setae, particularly on anterolateral angles, laterally, and posteriorly; tegula brown, with some yellow areas and long setae anteriorly; mesoscutellum broadly parabolic, with medial posterior margin slightly truncate (Fig. 2), anterior margin with faint short notch medially, yellowish ferruginous with posterior margin slightly lighter, with pale micropubescence and longer fuscous setae posteriorly; metanotum yellow ferruginous, slightly darker laterally. Mesepisternum largely yellow ferruginous, with dark brown area over much of upper half of surface (Fig. 1); metepisternum yellow (Fig. 1). Wing membranes weakly and lightly infusate, hyaline, with some faint magenta and green iridescence; veins, including pterostigma, dark brown although Rs+M and weakened veins more faintly pigmented (Fig. 8); venation as typical for genus, similar to that of *N. mirandula* (Fig. 7). Coxae, trochanters, and femora yellow ferruginous except small dark patch distally on metafemur (Fig. 1); setae of legs largely yellowish to lightly fuscous except apically on femora and on tibiae and tarsi darker; pro- and mesotibia reddish brown, with lighter areas anteriorly; pro- and mesotarsus reddish brown; metatibia outer surface entirely dark brown, lighter so in apical two-thirds posteriorly, apical fifth anteriorly (Fig. 3), inner surface with broad yellow area along posterior margin; metatibia length on posterior margin 1.52 mm, maximum width 0.60 mm; metatibia and metabasitarsus with largely dark fuscous setae, corbicular surface with at least three elongate simple setae, two positioned posteriorly, one posterior of midline (Fig. 3); metabasitarsus and remaining metatarsomeres reddish brown as on apical portion of metatibia; metabasitarsus length 0.73 mm, width 0.34 mm. Propodeum smooth and shiny, without pubescence, largely yellow, particularly laterally, upper lateral areas darker, yellow ferruginous to brown (Figs. 1, 2).

Metasomal terga with yellowish brown integument, T1-3 with dark brown subapical bands, T4 with apical margin a little more brown, T5-6 with bands well-defined; T4-6 with dark brown setae; sterna with integument and pubescence yellowish; setal insertions dark.

♀: Unknown.

♂: Unknown.

HOLOTYPE: ♀, Costa Rica, Prov. [Province] Limón, Pococí [canton], R.F. [Reserva Forestal] Cordillera Volcánica Central, Las Minas, 400–500 m, 11–18 Abr [April] 2012, W. Porras, tp. [trap] malaise, L_N_240821_545778 #105501. The holotype will be deposited in the collections of the Instituto Nacional de Biodiversidad, Santo Domingo de Heredia, Costa Rica, but is temporarily housed in the Division of Entomology, University of Kansas Natural History Museum, Lawrence, Kansas, USA.

ETYMOLOGY: The specific epithet refers to Costa Rica, the country in which the holotype was captured.

COMMENTS: This is a relatively small, slender bee with distinctive patterns of yellow contrasting with the darker areas of the head and mesosoma. These patterns do not appear to be intermediate in form between the two color morphs for *N. mirandula* and we therefore consider them to be indicative of a separate species, although discovery of nests in the region and perhaps the application of molecular techniques will be necessary to corroborate or refute this hypothesis. The species is superficially similar in appearance to the common *Tetragonisca angustula* (Latreille) or some *Plebeia*, such as *Plebeia pulchra* Ayala.

Key to Species of *Nogueirapis* (workers only)

1. Mesoscutellum, sides of mesosoma, propodeum, and metasoma yellowish or yellowish brown 2
- Mesoscutellum, sides of mesosoma, propodeum, and metasoma dark brown to black *N. mirandula* (Cockerell) (melanic form)
- 2(1). Dark area on frons not completely divided medially in front of median ocellus by yellow or ferruginous integument, yellow or ferruginous facial markings well separated from median ocellus (Fig. 4) 3
- Dark area of frons completely divided medially by yellow or ferruginous integument to the level of median ocellus (Figs. 5, 6) 4
- 3(2). Dark area of frons extending paramedially toward antennal toruli, such areas either terminating midway between ocelli and antennal toruli or sometimes continuing to toruli as light brown; mesoscutum yellow ferruginous; metatibia yellow ferruginous except outer apical third dark brown *N. butteli* (Friese)
- Dark area on frons extending paramedially toward antennal toruli but do not meet upper torular margins, laterally extended ventrally as narrow lines nearing reaching epistomal sulcus outside anterior tentorial pit, separating narrow yellow paraocular area from yellow of face bordering clypeus and antennal toruli (Fig. 4); mesoscutum black (Fig. 2); metatibia entirely dark brown (Figs. 1, 3) *N. costaricana*, n. sp.
- 4(2). Larger species (head width 1.86 mm, forewing length 4.00 mm); dark area of frons completely divided medially by narrow line of yellow/ferruginous integument tapering in width to median ocellus *N. mirandula* (Cockerell) (ferruginous form)
- Smaller species (head width 1.64 mm, forewing length 3.60 mm); dark area of frons completely divided medially by line of yellow integument that widens toward median ocellus *N. minor* (Moure & Camargo)

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