



## Six new species of the parasitoid wasp genus *Notiospathius* (Hymenoptera: Braconidae: Doryctinae) from Mexico

### Seis nuevas especies del género de avispas parasitoides *Notiospathius* (Hymenoptera: Braconidae: Doryctinae) de México

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**Abstract.** Six new species of the doryctine wasp genus *Notiospathius* (Braconidae) are described for the states of Jalisco, Oaxaca and Veracruz, Mexico: *N. bisulcatus* sp. n., *N. chinanteco* sp. n., *N. crypticus* sp. n., *N. laurae* sp. n., *N. mariachi* sp. n. and *N. tuxtlaensis* sp. n. DNA barcoding sequences are provided for these species. They represent the first confirmed records of species of *Notiospathius* in Mexico.

Key words: DNA barcoding, integrative taxonomy, Neotropics, cyclostome, Neotropics.

**Resumen.** Se describen 6 especies nuevas del género de avispas parasitoides *Notiospathius* (Braconidae) para los estados de Jalisco, Oaxaca y Veracruz, México: *N. bisulcatus* sp. n., *N. chinanteco* sp. n., *N. crypticus* sp. n., *N. laurae* sp. n., *N. mariachi* sp. n. y *N. tuxtlaensis* sp. n. Se incluyen secuencias del código de barras del ADN para las especies nuevas, las cuales representan los primeros registros confirmados de especies de *Notiospathius* para México.

Palabras clave: Código de barras del ADN, taxonomía integradora, ciclostomo, Neotrópico.

## Introduction

The doryctine genus *Notiospathius* Matthews and Marsh (Braconidae) represents one of the most speciose braconid genera in the Neotropics, currently containing 38 described and a large number of undescribed species (López-Estrada et al., 2012; Ceccarelli et al., 2012; Ceccarelli and Zaldívar-Riverón, 2013). Similar to other doryctine genera, members of *Notiospathius* possess a considerably elongated basal sternal plate of the first metasomal tergite. In particular, species of this genus are morphologically similar to those of 3 unrelated doryctine genera: the cosmopolitan *Spathius* Nees and 2 Neotropical genera, the recently erected *Bolivar* (Zaldívar-Riverón et al., 2013) and an undescribed genus characterized by having a mesoscutum sharply pointed anteriorly (Ceccarelli and Zaldívar-Riverón, 2013). *Notiospathius*, however, can be distinguished from the latter genera by having the following combination of characters: anterior part of mesoscutum rounded; mesoscutal lobes always

sculptured; propodeal areola absent; notauli obscuring in a rugose and/or longitudinally costate area, often not reaching the end of mesoscutum; first subdiscal cell of fore wing open at apex; vein m-cu interstitial or arising basally to vein 2RS, thus vein (RS + M)b present; and vein m-cu of hind wing not curved distally.

Ceccarelli et al. (2012) recently showed the existence of a considerable, highly overlooked species richness in *Notiospathius* using 3 gene markers and a coalescent approach. Here, we describe 6 of the new species delimited in the above study from Mexico. Other Mexican undescribed species of *Notiospathius* delimited by Ceccarelli et al. (2012) could not be described because we lack well-preserved females for these, whereas other one belongs to a species group that lacks the vein 2RS and will be described separately. The species included in our study represent the first confirmed records of described species of the genus for Mexico. Cauich et al. (2012) previously reported 8 described species of *Notiospathius* for northern Yucatan, in southeastern Mexico. These identifications, however, are considerably uncertain since it appears that all their recorded doryctine species were automatically assigned to one of the Costa Rican species included in Marsh (2002)

only after using his keys and without carrying out a more detailed examination of characters.

### Materials and methods

**Specimens and terminology.** Most of the specimens included in this work were collected in various field trips carried out during 2007-2012 in the states of Jalisco, Oaxaca and Veracruz, Mexico. These specimens were preserved in 100% ethanol, kept at  $-20^{\circ}\text{C}$  until some were processed for DNA sequencing. Specimens were subsequently dried, labelled, mounted, and deposited at the Colección Nacional de Insectos, Instituto de Biología, Universidad Nacional Autónoma de México (CNIN IB-UNAM), and Departamento de Ecología e Biología Evolutiva, Universidade Federal de São Carlos, São Carlos, SP, Brazil (DCBU). Three specimens collected in 1972 were deposited at the Canadian National Collection, Ottawa, Canada (CNC). Specimens were collected under the permit FAUT-208 of the Secretaría de Medio Ambiente y Recursos Naturales (Semarnat).

The terminology employed in this work follows Sharkey and Wharton (1997), except for the surface sculpture, which follows Harris (1979). We also employed the term precoxal sulcus instead sternaulus according to Wharton's (2006) proposal. Digital color pictures were taken with a Leica® Z16 APO-A stereoscopic microscope, a Leica® DFC295/ DFC290 HD camera, and the Leica Application Suite® program. Digital SEM photographs were taken at the Museo Nacional de Ciencias Naturales (CSIC, Madrid, Spain) with a FEI INSPECT® (Oregon, USA) SEM in low vacuum mode.

GeneBank accession numbers of sequences corresponding to the Barcoding locus [ $\sim 658$  bp of the cytochrome oxidase I mitochondrial (mt) DNA gene (COI); Hebert et al., 2003], as well as GeneBank accession numbers of 3 additional mt (cytochrome *b*) and nuclear (*wingless*, Elongation Factor-1 alpha) gene markers are provided for the 6 species described below. Most of these sequences are already published (Ceccarelli et al., 2012; Ceccarelli and Zaldívar-Riverón, 2013). The DNA extraction, amplification and sequencing protocols for the 4 COI sequences generated in this study are those mentioned in Ceccarelli et al. (2012). A key including the 44 currently described species of *Notiospathius* will be published elsewhere.

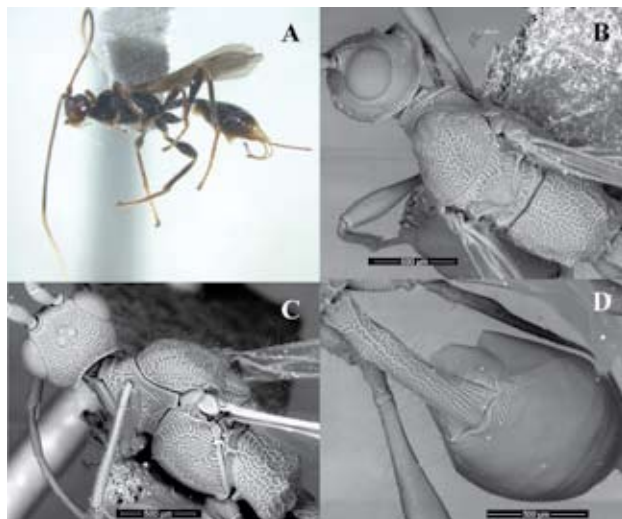
### Descriptions

***Notiospathius bisulcatus*** Reséndiz-Flores, Nunes and Zaldívar-Riverón sp. n.  
Figs. 1A-D, 2A.

**Diagnosis.** It can be distinguished from the remaining described species of the genus by the presence of 2 deep longitudinal median grooves running longitudinally along the anterior third of the median mesoscutal lobe.

**Female.** *Body length:* 4.5 mm; ovipositor 1.9 mm. *Color:* frons and gena dark brown, remaining head black; scape and pedicel brown; flagellomeres brown, apical 13 flagellomeres light yellow; palpi light yellow; mesosoma and metasoma black, except last 2 tergites which are brown (Fig. 1A); fore and middle coxae dark brown, trochanter and trochantellus light brown, femora dark brown, tibiae and tarsi brown; hind coxa dark brown to black, trochanter and trochantellus light yellow, femur dark brown, tibia light brown basally, remaining area dark brown, tarsi brown; wings dusky; veins brown; pterostigma light brown basally, brown apically; tegula brown; ovipositor brown, tip of ovipositor strongly sclerotized; sheaths light brown, turning darker towards apex. **Head:** vertex costate-strongly rugose; face striate-rugose; frons rugose; temple striate-rugose; gena smooth; clypeus rugose; eye height equal its width; malar space 0.3 times eye height; temple 0.66 times eye width (lateral view); hypoclypeal depression elliptic; ocular-ocellar distance about 2.0 times diameter of lateral ocellus; scape about the same length its width (frontal view); antenna with 30 flagellomeres.

**Mesosoma:** 2.1 times longer than high; pronotum strongly rugose; pronotal groove wide, deep and scrobiculate; propleuron costate-rugose; lateral mesoscutal lobes strongly rugose with a narrow longitudinal slightly



**Figure 1.** *Notiospathius bisulcatus* sp. n. Female. Holotype (CNIN 581): A, habitus, lateral view; B, head and mesosoma, dorsal view; C, mesosoma, lateral view; D, metasoma, dorsal view.

coriaceous-rugose median stripe (Fig. 1B); median mesoscutal lobe strongly rugose with 2 deep longitudinal grooves running along its anterior third; notauli wide, deep and scrobiculate, not joining, obscuring at the middle of mesoscutum in a strongly rugose area; scutellar disc smooth to slightly rugose, with sparse setae; scutellar sulcus with 6 longitudinal carinae; mesopleural sulcus wide, deep and scrobiculate, not joining subalar sulcus; subalar sulcus wide, deep and scrobiculate; mesopleuron porcate-slightly rugose dorsally, strongly rugose ventrally (Fig. 1C); precoxal sulcus wide, deep and scrobiculate, as long as mesopleuron; venter of mesosoma slightly rugose near precoxal sulcus remaining area smooth; propodeum strongly rugose-areolate, with slightly defined basally, incomplete median and sublateral longitudinal carinae; apical lateral corners short and blunt; spines over hind coxa absent. *Wings*: fore wing length 4.2 times its maximum width; length of pterostigma 3.0 times its maximum width; vein r 0.3 times length with vein 3RSa; vein m-cu interstitial with vein 2RS; vein 1cu-a postfurcal with vein 1M (Fig. 2A); hind wing vein M+CU 0.4 times length of vein 1M. *Legs*: hind coxa costate-rugose, basoventral tubercle absent, all femora smooth. *Metasoma*: first tergite longitudinally costate with rugose microsculpture, its length 2.8 times its apical width; basal sternal plate (acrosternite) about 0.7

times length of first tergite; second tergite longitudinally costate in “V” shape, with rugose microsculpture basally, remaining area smooth (Fig. 1D); remaining metasomal tergites smooth and polished; suture between second and third metasomal tergite absent; ovipositor about same length as metasoma.

*Variation*. Females. Body length: 4.2-4.5 mm; ovipositor length 1.2-1.9 mm; with 27-30 flagellomeres; mesosoma 2.0-2.1 times longer than high; fore wing length 3.8-4.2 times its maximum width; first metasomal tergite length 2.5-2.7 times its apical width; ovipositor length about 0.7-1.0 times length of metasoma.

*Male*. Similar to female.

*Taxonomic summary*

*Distribution*. The type series of this species was collected in the municipalities of Pluma Hidalgo and Candelaria Loxicha, in southeastern Oaxaca, Mexico.

*Biology*. Unknown.

*Etymology*. The name refers to the presence of 2 distinct anterior grooves in the median mesoscutal lobe.

*Holotype*. Female (CNIN IB-UNAM). Mexico, Oaxaca, Mun. Pluma Hidalgo, El Carmen, 15.88004 N 96.38911 W. 20/VI/2010, sweep, 613 m, S. Ceccarelli, H. Clebsch and V. De Jesús colls.; DNA voucher no. CNIN 581, GenBank accession nos (COI) JN870434; (cyt *b*) JN870605; (*wingless*) KC822103; (EF-1alpha) KC822031.

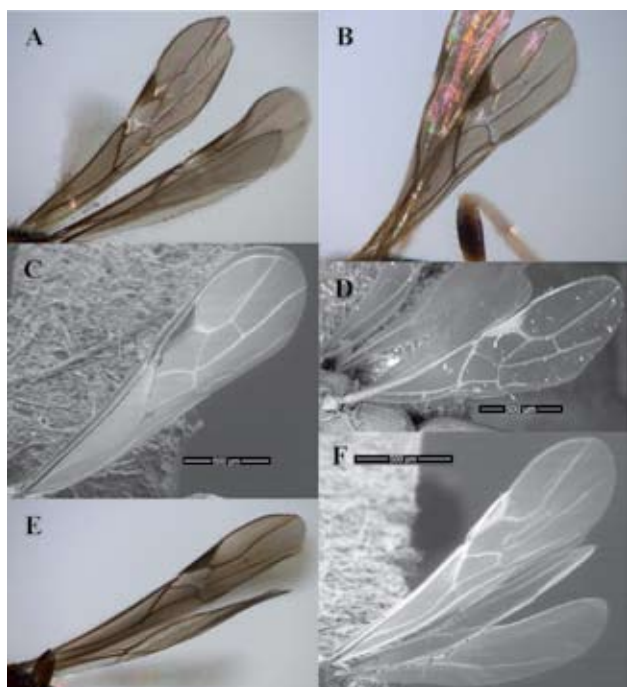
*Paratypes*. 2 specimens, 1 female, 1 male (CNIN IB-UNAM). 1 female: Mexico, Oaxaca, Candelaria Loxicha, 15°58'1" N, 96°28'11" W. 16-21/VI/2010, yellow plates trap, 1167 m, S. Ceccarelli, H. Clebsch and V. De Jesús colls.; DNA voucher no. CNIN 577, GenBank accession no. (COI) JN870604. 1 male: Mexico, Oaxaca, Candelaria Loxicha, 15°58'1" N, 96°28'11" W. 16-21/VI/2010, yellow plates trap, 1167 m, S. Ceccarelli, H. Clebsch and V. De Jesús colls.; DNA voucher no. CNIN 574, GenBank accession no. (COI) JN870430.

*Notiospathius chinanteco* Reséndiz-Flores, Nunes and Zaldívar-Riverón sp. n.

Figs. 2B, 3A-D.

*Diagnosis*. *Notiospathius chinanteco* runs to *N. badius* in Marsh's (2002) key but it differs from this species by having most of the second and remaining metasomal tergites smooth (second and third tergites at least partially sculptured in *N. badius*), and the mesopleuron, propodeum and first metasomal tergite black (honey yellow, occasionally dark brown in *N. badius*).

*Female*. *Body length*: 4.2 mm; ovipositor length 3.8 mm. *Color*: head brown with yellow gena; scape and pedicel brown; basal flagellomeres light brown, turning dark brown to apex, last 4-9 pale yellow; palpi light yellow; mesoscutum, propleuron and subalar area of mesopleuron brown, remainder area of mesosoma dark brown to black



**Figure 2.** Fore wings: A, *N. bisulcatus* sp. n.; B, *N. chinanteco* sp. n.; C, *N. crypticus* sp. n.; D, *N. laurae* sp. n.; E, *N. tuxtlaensis* sp. n.; F, *N. mariachi* sp. n.

(Fig. 3A); first metasomal tergite dark brown; remaining metasomal tergites brown to honey yellow; fore and middle coxae, trochanter and trochantellus light yellow, femora, tibiae and tarsi light brown; hind coxa dark brown turning yellow apically, trochanter and trochantellus yellow, femur light brown on basal third, brown on apical 2/3, tibia and tarsi brown; wings dusky; veins brown; pterostigma brown; tegula light yellow. Ovipositor brown, tip of ovipositor strongly sclerotised; sheaths honey yellow with brown apex. *Head*: face striate; frons striate-rugose; temple and gena smooth; vertex striate (Fig. 3B); clypeus acinose; eye height 0.9 times its width; malar space 0.3 times eye height; temple 0.3 times eye width (dorsal view); hypoclypeal depression elliptic; ocular-ocellar distance 2.0 times diameter of lateral ocellus; length of scape 1.75 times its width (frontal view); antennae with 25-27 flagellomeres. *Mesosoma*: length of mesosoma 2.1 times its maximum height; pronotum rugose; pronotal groove wide, deep, smooth to slightly scrobiculate; propleuron smooth to almost indistinct coriaceous; lateral mesoscutal lobes transversely costate-rugose with a longitudinal median stripe slightly coriaceous-rugose; median mesoscutal lobe costate-rugose (Fig. 3C); notauli deep and scrobiculate anteriorly, obscuring at half of mesoscutum in a longitudinally porcate-rugose area; scutellar disc smooth; scutellar sulcus with 5 longitudinal carinae; mesopleuron porcate dorsally, smooth medially and ventrally; mesopleural and subalar sulcus almost indistinct (Fig. 3B); precoxal sulcus wide, deep, scrobiculate, as long as mesopleuron; venter of

mesosoma smooth; propodeum strongly rugose-areolate, without distinct longitudinal carinae; apical lateral corners short and blunt, spines over hind coxa present and sharp. *Wings*: fore wing length 3.9 times its maximum width; length of pterostigma 5.0 times its maximum width; vein r 0.3 times length vein 3RSa; vein m-cu reaching first submarginal cell before vein 2RS; vein (RS+M)b present (Fig. 2B); vein 1cu-a slightly postfurcal to vein 1M; hind wing vein M+CU 0.4 times length of vein 1M. *Legs*: hind coxa costate-rugose, basoventral tubercle absent, all femora smooth. *Metasoma*: first tergite longitudinally costate with rugose microsculpture, its length 3.3 times its apical width; basal sternal plate (acrosternite) about 0.8 times length of first tergite; second tergite slightly longitudinally costate baso-laterally, coriaceous baso-medially, remaining area smooth (Fig. 3D); remaining metasomal tergites smooth and polished; suture between second and third metasomal tergite indistinct; ovipositor 1.7 times of metasoma.

*Variation*. Females. Eye 0.9-1.2 times higher than width; temple 0.3-0.4 times eye width; antenna with 25-27 flagellomeres (broken); apical 4-9 flagellomeres pale yellow. Length of mesosoma 2.0-2.1 times its maximum height; fore wing length 3.9-4.5 times its maximum width; pterostigma length 4-5 times its maximum width; length of first metasomal tergite 3.2-3.3 times its apical width.

*Male*. Similar to female; body length 3.1-3.8 mm.

#### *Taxonomic summary*

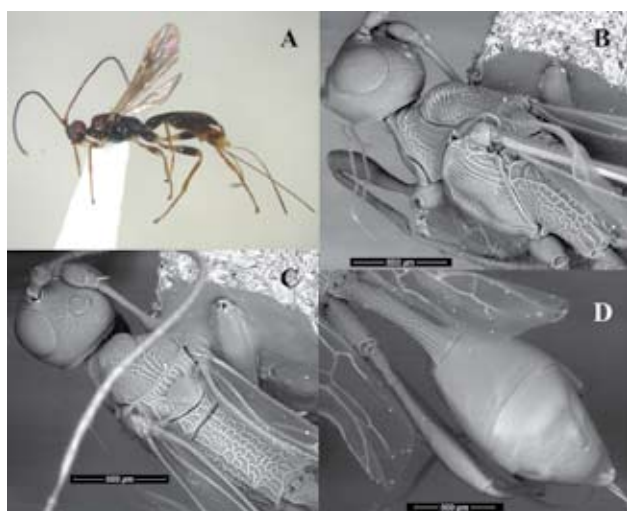
*Distribution*. Northeastern Oaxaca and southeastern Veracruz, Mexico.

*Biology*. Unknown.

*Etymology*. This species was named after the native language that is spoken in Santiago Comaltepec, Sierra de Juárez, northeastern Oaxaca, the region where type specimens of these species were collected.

*Holotype*. Female (CNIN IB-UNAM). Mexico, Oaxaca, Valle Nacional, Santiago Progreso, 17°42'40" N, 96°15'51" W. 7/VI/2009, sweep, 147 m, A. Zaldívar and H. Clebsch colls.; DNA voucher no. CNIN 465, GenBank accession nos (COI) JN870340; (cyt b) JN870520; (*wingless*) JN870680.

*Paratypes*. 8 specimens, 3 males, 5 females (CNIN IB-UNAM). 1 male: Mexico, Veracruz, Los Tuxtlas, sweep, 2007, B. Ruiz coll.; DNA voucher no. CNIN636; GenBank accession nos (COI) JN870453; (cyt b) JN870612; (*wingless*) JN870734. 1 female: Mexico, Oaxaca, Santiago Comaltepec, 17°42'11" N, 96°18'15" W. 7/VI/2009, yellow plates trap, 703 m, A. Zaldívar and H. Clebsch colls.; DNA voucher no. CNIN359, GenBank accession nos (COI) JN870286; (*wingless*) JN870618; (EF-1alpha) KC822023. 1 male, 2 females: Mexico, Veracruz, Est. Biol. Los Tuxtlas, 18°35'6" N, 95°4'30" W, 151 m, sweep, remanente selva alta perennifolia, A. Zaldívar, H. Clebsch



**Figure 3.** *Notiospathius chinanteco* sp. n. Female. Holotype (CNIN 465): A, habitus, lateral view; B, head and mesosoma, dorsolateral view; C, mesosoma, dorsal view; D, metasoma, dorsal view.

colls.; DNA voucher nos CNIN793, GenBank accession no. JX870422. 1 male, 2 females: Mexico, Veracruz, Est. Biol. Los Tuxtlas, cam. Vigia, 18°35'6" N, 95°4'29" W, 141 m, sweep 9-11 hrs, remanente bosque tropical, A. Zaldívar, J. Mtz., and H. Clebsch colls.

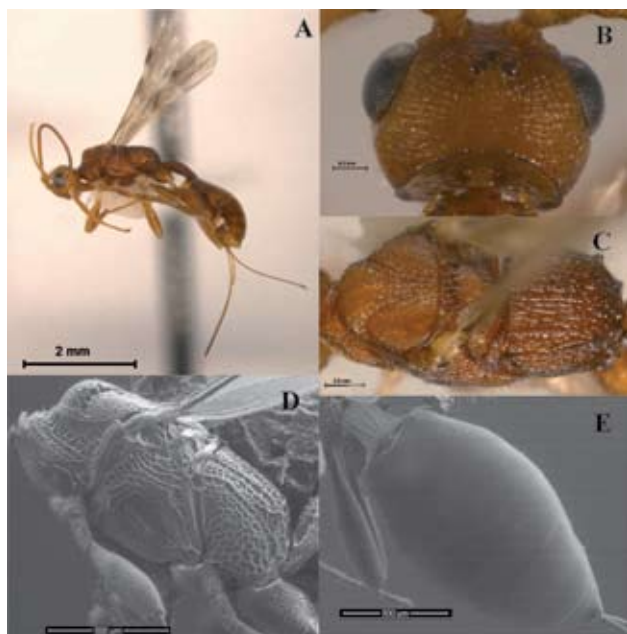
*Notiospathius crypticus* Reséndiz-Flores, Nunes and Zaldívar-Riverón sp. n.

Figs. 4A-E, 2C.

**Diagnosis.** Morphologically very similar to *N. mariachi* sp. n., but it differs from the latter species by having a larger body size (4.0 mm; 2.6-3.0 mm in *N. mariachi* sp. n.); ocelli dark brown (white in *N. mariachi* sp. n.); propodeum longitudinally costate-rugose dorsally and laterally, rugose-areolate at apex (mostly rugose-areolate in *N. mariachi* sp. n.) and second metasomal tergite striate "V" shaped on basal third, longitudinally striate sublaterally on basal 3/4, remaining area smooth (striate "V" shaped laterally and slightly acinose to smooth medially on basal half, remaining area smooth in *N. mariachi* sp. n.).

**Female.** *Body length:* 4.0 mm, ovipositor 2.2 mm. *Color:* body brownish orange (Fig. 4A); ocelli dark brown; flagellomeres brownish orange, becoming lighter to apex; palpi light brown; fore and middle coxae, trochanter and trochantellus pale yellow, femora, tibiae and tarsi brownish orange; hind coxa brownish orange, trochanter and trochantellus pale yellow, femur, tibia and tarsi

brownish orange; wings slightly banded; veins brown; pterostigma dark brown apically, pale yellow basally; tegula pale yellow; ovipositor brown, ovipositor apex strongly sclerotised; sheaths brown becoming darker to apex. **Head:** clypeus slightly rugose-acinose; face finely striate with acinose microsculpture; frons rugose; vertex striate-rugose (Fig. 4B); temple slightly striate, gena smooth; eye height 1.5 times its width; malar space 0.5 times eye height; temple with same length as eye width (lateral view); hypoclypeal depression elliptic; ocular-ocellar distance 3 times diameter of lateral ocellus; length of scape 1.5 times its width (frontal view); antenna with 28 flagellomeres. **Mesosoma:** length of mesosoma 2.0 times longer than high; pronotum striate-rugose laterally; pronotal groove slightly scrobiculate; propleuron striate-rugose; mesoscutal lobes coriaceous (Fig. 4C); notauli wide, deep, scrobiculate, joining at the middle of mesoscutum in a longitudinally costate-rugose area; scutellar disc coriaceous; scutellar sulcus with 5 longitudinal carinae; mesopleural and subalar sulcus continuous, both wide, deep and scrobiculate; mesopleuron porcate-coriaceous dorsally, coriaceous medially and ventrally (Fig. 4D); precoxal sulcus wide, deep and scrobiculate, as long as mesopleuron; venter of mesosoma coriaceous-slightly rugose; propodeum longitudinally costate-rugose dorsally and laterally, rugose-areolate at apex; median and dorsal lateral carinae of propodeum distinguishable beyond middle of propodeum; apical lateral corners short and blunt; spines over hind coxa short and blunt. **Wings:** fore wing 3.9 times length its maximum width; length of pterostigma 4.5 times its maximum width; fore wing vein r 0.5 times length of vein 3RSa; vein m-cu reaching first submarginal cell before vein 2RS; vein (RS+M)b present (Fig. 2C); vein 1cu-a slightly postfurcal to vein 1M; hind wing vein M+CU 0.65 times length of vein 1M. **Legs:** hind coxa strongly rugose-coriaceous dorsally, slightly rugose-coriaceous ventrally, basoventral tubercle present; hind and middle femora slightly coriaceous. **Metasoma:** first tergite longitudinally costate with rugose microsculpture, 2.7 times length its apical width; acrosternite 0.7 times length of first tergite; second tergite striate "V" shaped with rugose microsculpture on basal third, longitudinally striate with coriaceous microsculpture sublaterally on basal 3/4, remaining area smooth (Fig. 3E); remaining tergites smooth and polished; suture between second and third tergites absent; ovipositor 1.1 times length of metasoma. **Variation.** Females. Ovipositor 2.0-2.2 mm; fore wing 3.5-3.9 times length its maximum width; length of pterostigma 4.0-4.5 times its maximum width; first metasomal tergite 2.5-2.7 times length its apical width; acrosternite 0.6-0.7 times length of first tergite; ovipositor 0.9-1.1 times length of metasoma.



**Figure 4.** *Notiospathius crypticus* sp. n. Female. Holotype (ASDOR 016): A, habitus, lateral view; B, head, dorsal view; C, mesosoma, dorsal view; D, mesosoma, lateral view; E, metasoma, dorsal view.

*Male.* Unknown.

*Taxonomic summary*

*Distribution.* Southwestern Jalisco, Mexico.

*Biology.* Unknown.

*Etymology.* The name of this species refers to its considerable external morphological similarity with other species described in this study, *N. mariachi* sp. n.

*Holotype.* Female (CNIN IB-UNAM). Mexico, Jalisco, Chamela station, road Chachalaca, 19°29'57" N, 105°2'17" W. 25/VI/2009, sweep, 56 m, H. Clebsch, A. Zaldívar and A. Polaszek colls.; DNA voucher no. ASDOR 0016, GenBank accession no. (COI) JF912317.

*Paratypes.* Female (DCBU): Mexico, Jalisco, Chamela station, road Chachalaca, 19°29'57" N, 105°2'17" W. 26-27/VI/2009, yellow plates trap. 56 m, H. Clebsch, A. Zaldívar and A. Polaszek colls.; DNA voucher no. ASDOR 0017, GenBank accession nos (COI) JF912318; (cyt *b*) KC822245.

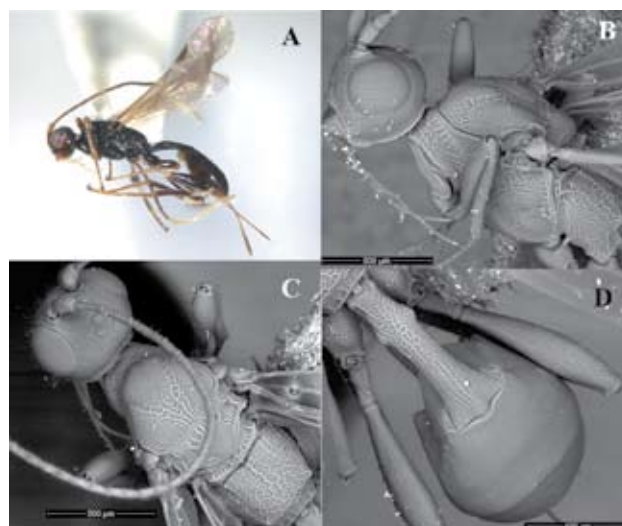
*Remarks.* This and 2 other Mexican species, 1 undescribed [4 males; DNA voucher no. CNIN 575, 583, 584, 587; GenBank accession no. (COI) JN870431] and one other described below (*N. mariachi* sp. n.) are morphologically similar and appeared nested together in a clade within a major *Notiospathius* clade in Ceccarelli and Zaldívar-Riverón's (2013) molecular phylogenetic study. Among the morphological features shared by these 3 species are a vertex striate-strongly rugose, slightly banded wings and relatively swollen hind femur. The latter 2 features are similar to those present in species of *Tarasco* (Ceccarelli and Zaldívar-Riverón, 2013); however, the phylogenetic placement and overall morphology of the aforementioned 3 species confirm its placement within *Notiospathius*.

*Notiospathius laurae* Reséndiz-Flores, Nunes and Zaldívar-Riverón sp. n.

Figs. 2D, 5A-D.

*Diagnosis.* This species runs in the key provided by Marsh (2002) and Zaldívar-Riverón and De Jesus-Bonilla's (2010, 2011) extension to *N. striatifrons*; however, *N. laurae* mainly differs from the later species by having a gena entirely dark brown (honey yellow in *N. striatifrons*), and second metasomal tergite entirely costate with rugose microsculpture (weakly rugose mid-basally, costate in basal lateral areas, remaining area smooth in *N. striatifrons*).

*Female.* *Body length:* 3.2 mm; ovipositor length 1.2 mm. *Color:* head dark brown; scape and pedicel brown; flagellomeres brown, apical 10 flagellomeres light brown; palpi light yellow. Mesosoma and metasoma dark brown to black (Fig. 5A); fore and middle coxae brown, trochanter and trochantellus light brown, femur dark brown, tibia and tarsi brown; hind coxa dark brown to black, trochanter and trochantellus light yellow, femur dark brown, tibia light brown at basal third, dark brown apically, tarsi brown;



**Figure 5.** *Notiospathius laurae* sp. n. Female. Holotype (CNIN 644): A, habitus, lateral view; B, head and mesosoma, dorsolateral view; C, mesosoma, dorsal view; D, metasoma, dorsal view.

wings slightly dusky; veins and pterostigma brown; tegula brown. Ovipositor brown, tip of ovipositor strongly sclerotized; sheaths light brown. *Head:* face and vertex striate-rugose (Fig. 5B); frons with concentric rugosities; temple and gena smooth; clypeus slightly rugose; eye height same length its width; malar space 0.3 times eye height; temple 0.3 times eye width (lateral view); hypoclypeal depression elliptic; ocular-ocellar distance 2.0 times diameter of lateral ocellus; length of scape 1.5 times its width (frontal view); antennae with 23-24 flagellomeres. *Mesosoma:* length of mesosoma 1.9 times longer than high; pronotum rugose dorsally and laterally; pronotal groove wide and scrobiculate; propleuron slightly striate-rugose anteriorly, slightly coriaceous posteriorly; mesoscutal lobes coriaceous, slightly rugose-coriaceous along edges (Fig. 5C); notauli wide, deep, scrobiculate, not joining, finishing after middle of mesoscutum in a longitudinally costate-rugulose area; scutellar disc coriaceous; scutellar suscus with 5 longitudinal carinae; mesopleural sulcus wide, deep and scrobiculate, joining subalar sulcus; subalar sulcus distinct and scrobiculate; mesopleuron rugose-slightly coriaceous dorsally, coriaceous medially and ventrally (Fig. 5B); precoxal sulcus wide, deep and scrobiculate, as long as mesopleuron; venter of mesosoma coriaceous, propodeum rugose-areolate, with slightly defined, incomplete median and sublateral longitudinal carinae; spines at apical lateral corners short and blunt; spines over hind coxa absent. *Wings:* fore wing length 4.0 times higher than its maximum width; pterostigma length 3.6 times longer its maximum width; fore wing vein r 0.5 times

length of vein 3RSa (Fig. 2D); vein m-cu reaching first submarginal cell before vein 2RS; vein (RS+M)b present; vein 1cu-a slightly postfurcal to vein 1M; hind wing vein M+CU 0.6 times length of vein 1M. Legs: hind coxa rugose-coriaceous, basoventral tubercle absent; femora slightly coriaceous. *Metasoma*: first tergite longitudinally costate with rugose microsculpture, its length 2.7 times its apical width; basal sternal plate (acrosternite) 0.7 times length of first tergite; second tergite longitudinally costate with rugose microsculpture; remaining metasomal tergites smooth (Fig. 5D); suture between second and third tergites almost indistinct, straight; ovipositor 0.8 times length of metasoma.

*Variation*. Females. Body length 3.0-3.3 mm; ovipositor length 1.1-1.2 mm; eye height 1.0-1.2 times its width; temple 0.3-0.4 times eye width; antenna with 24-25 flagellomeres; mesosoma 1.8-1.9 times longer than high; fore wing length 4.0-4.6 times higher its maximum width; fore wing vein r 0.35-0.5 times length of vein 3RSa; first metasomal tergite length 2.3-2.7 times higher than its apical width; ovipositor length 0.7-0.8 times length of metasoma.

*Male*. Unknown.

#### *Taxonomic summary*

*Distribution*. This species was collected in San Agustín Loxicha and Santiago la Galega, southeastern Oaxaca, Mexico.

*Biology*. Unknown.

*Etymology*. This species was named after the first author's girlfriend, Laura Díaz-Álvarez.

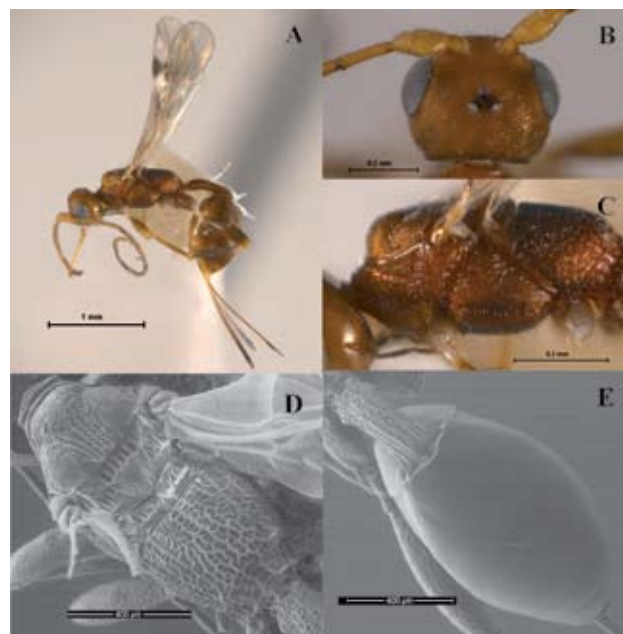
*Holotype*. Female (CNIN IB-UNAM). Mexico, Oaxaca, San Agustín Loxicha, 16°0'43" N, 96°31'53" W. 19/VI/2010, sweep, 1387 m, S. Ceccarelli, H. Clebsch and V. de Jesús colls.; DNA voucher no. CNIN 644, GenBank accession no. (COI) JN870614.

*Paratypes*. 2 females (CNIN IB-UNAM). 1 female: Mexico, Oaxaca, San Agustín Loxicha, 16°0'43" N, 96°31'53" W. 19/VI/2010, sweep, 1387 m, S. Ceccarelli, H. Clebsch and V. de Jesús colls.; DNA voucher no. CNIN 571, GenBank accession nos (COI) JN870427 (cyt *b*) JN870602; (*wingless*) JN870725; (EF-1alpha) KC822055; 1 female: Mexico, Oaxaca, Candelaria Loxicha, 15°58'6" N, 96°28'19" W. 19-21/VI/2010, yellow plates, 1159 m, S. Ceccarelli, H. Clebsch and V. de Jesús colls.; DNA voucher no. CNIN 572, GenBank accession number (COI) JN470828.

*Notiospathius mariachi* Reséndiz-Flores, Nunes and Zaldivar-Riverón sp. n.  
Figs. 2F, 6A-E.

*Diagnosis*. Morphologically very similar to *N. crypticus*, but see differences between them in the diagnosis of the latter species.

*Female*. *Body length*: 2.6 mm, ovipositor 1.4 mm. *Color*: mesosoma and metasoma brownish orange (Fig. 6A); head, scape and pedicel slightly lighter; ocelli white; flagellomeres brownish orange, becoming lighter to apex; palpi brown; fore and middle coxae, trochanter and trochantellus pale yellow, femora, tibiae and tarsi brown-orange; hind coxa brown-orange, pale yellow apically, trochanter and trochantellus pale yellow, femur, tibia and tarsi brown-orange; wings slightly banded; veins brown; pterostigma dark brown apically, pale yellow basally; tegula pale yellow; ovipositor brown, ovipositor apex strongly sclerotised; sheaths brown becoming darker to apex. *Head*: clypeus slightly rugose-acinose; face finely striate-rugose; frons slightly rugose; vertex striate-rugose (Fig. 6B); temple and gena smooth; eye height 1.3 times its width; malar space 0.5 times eye height; temple with same length as eye width (lateral view); hypoclypeal depression elliptic; ocular-ocellar distance 4 times diameter of lateral ocellus; length of scape 1.2 times its width (frontal view); antenna with 18 flagellomeres. *Mesosoma*: length of mesosoma 2.0 times longer than high; pronotum striate-rugose laterally; pronotal groove slightly scrobiculate; propleuron slightly rugose; mesoscutal lobes coriaceous (Fig. 6D); notauli wide, deep, scrobiculate, joining at the middle of mesoscutum in a longitudinally costate-rugose area area; scutellar disc coriaceous; scutellar sulcus with



**Figure 6.** *Notiospathius mariachi* sp. n. Female. Holotype (ASDOR 463): A, habitus, lateral view; B, head, dorsal view; C, mesosoma, lateral view; D, mesosoma, dorsal view; E, metasoma, dorsal view.

3 longitudinal carinae; mesopleural and subalar sulcus continuous, both wide, deep and scrobiculate; mesopleuron porcate-coriaceous dorsally, coriaceous medially and ventrally (Fig. 6C); precoxal sulcus wide, deep and scrobiculate, as long as mesopleuron; venter of mesosoma coriaceous; propodeum rugose-areolate; median and dorsal lateral carinae of propodeum only distinguishable basally; apical lateral corners short and blunt; spines over hind coxa indistinguishable. *Wings*: fore wing 3.4 times length its maximum width; length of pterostigma 3.0 times its maximum width; fore wing vein r 0.4 times length of vein 3RSa; vein m-cu reaching first submarginal cell before vein 2RS (Fig. 2F); vein (RS+M)b present; vein 1cu-a slightly postfurcal to vein 1M; hind wing vein M+CU 0.6 times length of vein 1M. *Legs*: hind coxa rugose-coriaceous dorsally, coriaceous ventrally, basoventral tubercle present; hind femur coriaceous. *Metasoma*: first tergite longitudinally costate with rugose microsculpture, 2.5 times length its apical width; acrosternite 0.7 times length of first tergite, second tergite striate "V" shaped with rugose microsculpture laterally, slightly acinose to smooth medially on basal half, remaining area smooth and polished (Fig. 6E); remaining tergites smooth and polished; suture between second and third tergites absent; ovipositor with same length as metasoma.

*Variation*. Females. Body length 2.6-3.0 mm; ovipositor 1.4-1.8 mm; fore wing 3.4-3.8 times length its maximum width; acrosternite 0.6-0.8 times length of first metasomal tergite; ovipositor 1.0-1.2 times length of metasoma; antenna with 18-22 flagellomeres.

*Male*. Similar to female; body length 2.3-2.6 mm; second metasomal tergite costate to 0.8 of tergite, remaining area smooth; third tergite acinose to 0.8 of tergite basally, remaining area smooth.

*Taxonomic summary*

*Distribution*. Southwest Jalisco, Mexico.

*Biology*. Unknown.

*Etymology*. The name of this species refers to the most famous Mexican folk music, the mariachi music, which is typical from Jalisco, the state where its type series was collected.

*Holotype*. Female (CNIN IB-UNAM). Mexico, Jalisco, Chamela station, road Ardiilla, 19°30'15" N, 105°2'16" W. 20/ XI / 2009, sweep, 39 m, A. Zaldívar coll.; DNA voucher no. ASDOR 463, GenBank accession no. (COI) HM434544.

*Paratypes*. 4 specimens, 2 females, 2 males (CNIN IB-UNAM, DCBU). 1 male: Mexico, Jalisco, Chamela station, road Chachalaca, 19°29'57" N, 105°2'17" W. 26-27/ VI / 2009, yellow plates trap, 56 m, H. Clebsch, A. Zaldívar and A. Polaszek colls.; DNA voucher no. ASDOR 019, GenBank accession nos (COI) JF912320; (cyt b)

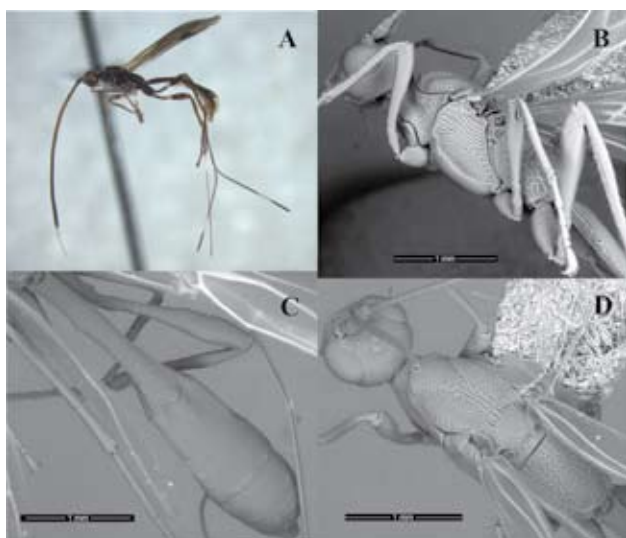
KC822246; (*wingless*) KC822110; (28S) HQ200668. 1 female: Mexico, Jalisco, Chamela station, road Chachalaca, 19°29'57" N, 105°2'17" W. 26-27/ VI / 2009, yellow plates trap, 56 m, H. Clebsch, A. Zaldívar and A. Polaszek colls.; DNA voucher no. ASDOR 018, GenBank accession no. (COI) JF912319. 1 male. Mexico, Jalisco, Chamela station, road Calandria, 19°30'17" N, 105°2'15" W. 3/ IX / 2009, sweep, 52 m, H. Clebsch and A. Zaldívar colls.; DNA voucher no. ASDOR 357, GenBank accession nos (COI) HM434507; (28S) HQ200669. 1 female. Mexico, Jalisco, Chamela station, road Calandria, 19°30'17" N, 105°2'15" W. 4/ IX / 2009, sweep, 52 m, H. Clebsch and A. Zaldívar colls.; DNA voucher no. ASDOR 355. DCBU). 1 male. Chamela station, road Chachalaca, 19°29'57" N, 105°2'17" W. 26-27/ VI / 2009, yellow plates trap, 56 m, col. H. Clebsch, A. Zaldívar DNA voucher no. ASDOR 019; GenBank accession nos (COI) JF912320; (cyt b) KC822246; (*wingless*) KC822110; (28S) HQ200668DCBU). Chamela station, road Calandria, 19°30'17" N, 105°2'15" W. 3/ IX / 2009, sweep, 52 m DNA voucher no. ASDOR 357; GenBank accession nos (COI) HM434507; (28S) HQ200669; Chamela station, road Chachalaca, 19°29'57" N, 105°2'17" W. 26-27/ VI / 2009, yellow plates trap, 56 m, col. H. Clebsch, A. Zaldívar colls. DNA voucher no. ASDOR 018; GenBank accession no. (COI) JF912319. 1 male. Mexico, Jalisco, Chamela station, road Calandria, 19°30'17" N, 105°2'15" W. 3/ IX / 2009, sweep, 52 m, col. H. Clebsch, A. Zaldívar, DNA voucher no. ASDOR 357; GenBank accession nos (COI) HM434507; (28S) HQ200669. 1 female. Mexico, Jalisco, Chamela station, road Calandria, 19°30'17" N, 105°2'15" W. 4/ IX / 2009, sweep, 52 m, col. H. Clebsch DNA voucher no. ASDOR 355.

*Notiospathius tuxtlaensis* Reséndiz-Flores, Nunes and Zaldívar-Riverón sp. n.

Figs. 2E, 7A-D.

*Diagnosis*. Considerably similar to *N. terminalis* Ashmead; however, it differs from the latter species mainly by having the hind coxa brown to dark brown (yellow with brown lateral spots in *N. terminalis*), and fourth and fifth metasomal tergites coriaceous to slightly coriaceous basally (entirely smooth in *N. terminalis*).

*Female*. Body length: 7.0 mm; ovipositor length 8.5 mm. *Color*: head dark brown; scape and pedicel dark brown; flagellomeres brown, apical segments white; palpi pale yellow. Mesosoma and first, second, fourth and fifth metasomal tergites dark brown, third tergite honey yellow laterally, dark brown medially, remaining tergites light yellow medially, dark brown laterally (Fig. 7A); fore and middle coxae, trochanter and trochantellus pale yellow, femora light yellow on basal third, dark brown to brown on apical 2/3, tibia and tarsi dark brown; hind coxa, trochanter



**Figure 7.** *Notiospathius tuxtlaensis* sp. n. Female. Paratype (CNIN 455): A, habitus, lateral view; B, head and mesosoma, lateral view; C, metasoma, dorsal view; D, mesosoma, dorsal view.

and trochantellus brown, femur pale yellow on basal third, dark brown on apical 2/3, tibia and tarsi brown. Wings banded; veins brown to light brown; pterostigma dark brown; tegula honey yellow. Ovipositor brown, ovipositor apex strongly sclerotised; sheaths dark brown, turning black apically, with a light yellow band pre-apically. **Head:** face, frons, vertex and superior part of temple, striate; gena smooth; clypeus acinose; eye height 0.8 times length eye width; malar space 0.5 times than eye height; temple 0.4 times eye width (lateral view); hypoclypeal depression elliptic; ocular-ocellar distance about 2.0 times diameter laterals ocellus; length of scape 2.0 times its width (frontal view); antenna with 26 flagellomeres (broken). **Mesosoma:** length of mesosoma 2.2 times its maximum height; pronotum rugose dorsally, costate-rugose laterally; pronotal groove wide, deep, slightly scrobiculate laterally and scrobiculated medially; propleuron acinose-costate, lateral mesoscutal lobes costate-slightly coriaceous transversely, with a median longitudinal stripe slightly rugose, median mesoscutal lobe costate-slightly coriaceous transversely (Fig. 7D); notauli wide, deep and scrobiculate, obscuring at half of mesoscutum in a longitudinally porcate area; scutellar disc smooth; scutellar groove with 5 longitudinal carinae; mesopleural sulcus shallow and porcate, not joining with subalar sulcus; subalar sulcus narrow and indistinct; mesopleuron porcate dorsally and medially, slightly rugose anteroventrally, smooth posteroventrally (Fig. 7B); precoxal sulcus narrow, scrobiculate, as long

as mesopleuron; venter of mesosoma smooth; propodeum strongly rugose-areolate with coriaceous microsculpture; longitudinal carinae absent; spines at apical-lateral corners absent, spines over hind coxa short and blunt. **Wings:** fore wing length 4.4 times its maximum width; pterostigma length 4 times its maximum width; fore wing vein r 0.25 times length of vein 3RSa; vein m-cu reaching first submarginal cell before vein 2RS; vein (RS+M)b present (Fig. 2E); vein 1cu-a antefurcal to vein 1M; hind wing vein M+CU 0.4 times length of vein 1M. **Legs:** femora with a more or less distinct mid-dorsal swelling area; middle tibia with a row of 6 spines; hind coxa slightly costate-rugose, basoventral tubercle absent; hind femur smooth. **Metasoma:** first tergite longitudinally costate with rugose microsculpture, its length 3.6 times its apical width; basal sternal plate (acrosternite) about 0.7 times length of first tergite; second and basal 3/4 of third metasomal tergites costate longitudinally with rugose microsculpture; suture between second and third metasomal tergites distinct and straight; third tergite with median transverse groove that curves slightly forward at sides; apical fourth of third metasomal tergite smooth; fourth tergite slightly coriaceous basally, smooth apically; fifth tergite almost indistinct coriaceous basally, smooth apically, remaining tergites smooth and polished (Fig. 7C); ovipositor about 1.8 times length of metasoma.

**Variation.** Females. Body length 5.3-7.0 mm; ovipositor 6.2-8.5 mm; antenna with 32-41 flagellomeres, last 10-14 flagellomeres white; temple smooth; fore wing length 4.4-5.6 times its maximum height; fore wing vein r 0.3 of 3RSa; fore wing vein 1cu-a interstitial or antefurcal to vein 1M; hind wing vein M+CU 0.35-0.5 times length of vein 1M; hind femur slightly acinose; first metasomal tergite 3.6-4.0 times its apical width; basal sternal plate (acrosternite) about 0.7-0.8 times length of first tergite; fifth tergite almost indistinct to slightly coriaceous basally; ovipositor about 1.8-1.9 times length of metasoma.

**Male.** Smaller than female, body length 3.5-6.2 mm; apical 2-6 flagellomeres white; mesosoma and metasoma brown to dark brown; fore wing vein 1cu-a interstitial or antefurcal to vein 1M; femora without blister-like swelling; fourth metasomal tergite coriaceous basally.

#### *Taxonomic summary*

**Distribution.** The type series was collected in localities situated along northeastern Oaxaca and southeastern Veracruz, Mexico. This region was originally covered by tropical rain forest, of which only remain some remnant areas.

**Biology.** Unknown.

**Etymology.** The name of this new species refers to Los Tuxtlas Biological Station located in Veracruz, place where most of its type series was collected.

*Holotype*. Female (CNIN IB-UNAM). Mexico, Oaxaca, Santiago Comaltepec, 17°37'42" N, 96°20'48" W. 6-8/VI/2009, yellow plates, 1495 m, A. Zaldívar and H. Clebsch colls.; DNA voucher no. CNIN 460, GenBank accession nos (COI) JN870335; (*wingless*) JN870675.

*Paratypes*. 25 specimens, 11 males, 14 females (CNIN IB-UNAM; DCBU; CNC). 3 females: Mexico, Veracruz, Los Tuxtlas, Res. Sta. 33 Km NE Catemaco, 01/VII/1983, 160 m, M. Kaulbars coll. 1 female: Mexico, Oaxaca, 15 mi. S. Valle Nacional, 21/VIII/1972, 1200 m, J. Helava coll. 1 male: Mexico, Veracruz, Los Tuxtlas, 18°35'8" N, 95°3'39" W. IX/ 2007, Malaise trap, 703 m, B. Ruiz coll.; DNA voucher no. CNIN 481, GenBank accession no. (COI) JN870353. 1 male, 1 female: Mexico, Oaxaca, Santiago Comaltepec, 17°42'11" N, 96°18'15" W, 7/VI/2009, yellow plates. 703 m, A. Zaldívar and H. Clebsch colls.; DNA voucher no. CNIN 358, 473, GenBank accession nos (COI) JN870285, 348; (*cyt b*) JN870457, 525; (*wingless*) JN870617, 685; (EF-1alpha) KC822037. 1 male: Mexico, Oaxaca, Santiago Comaltepec, 17°41'46" N, 96°19'18" W, 7-9/VI/2009, yellow plates trap, 711 m, A. Zaldívar and H. Clebsch colls.; DNA voucher nos CNIN 475, GenBank accession nos (COI) JN870350; (*cyt b*) JN870527. 1 male: Mexico, Oaxaca, Valle Nacional, Santiago Progreso, 17°42'40" N, 96°15'51" W, 7/VI/2009, sweep, 147 m, A. Zaldívar and H. Clebsch colls.; DNA voucher no. CNIN 466, GenBank accession nos (COI) JN870341 (*cyt b*) JN870521. 1 female: Mexico, Oaxaca, Santiago Comaltepec, 17°37'42" N, 96°20'48" W, 6-8-VI-2009, YPT/50 plates, 1495 m, A. Zaldívar, H. Clebsch, DNA voucher no. CNIN 455, GenBank accession no. (COI) JN870331; (*cyt b*) JN870671. 4 females, 7 males. Mexico, Veracruz, Est. Biol. Los Tuxtlas, 18°35'6" N, 95°4'30" W, 151 m, sweep, remanente selva alta perennifolia, A. Zaldívar, H. Clebsch, DNA voucher nos CNIN794, MNCN1, 6, 10, GenBank accession nos KF910719-21. 3 females: Mexico, Veracruz, Los Tuxtlas Res. Station, 33 Km NE Catemaco, 01-VII-1983, 160m, M.Kaulbars coll. 1 female, Mexico, Oaxaca, 15 mi. S. Valle Nacional, 21/VIII/1972 1200 m, J. Helava coll.

*Remarks*. We have examined 2 specimens from Guatemala and Honduras that apparently belong to 2 separate species that are morphologically similar to *N. tuxtlaensis* and *N. terminalis*. These undescribed species mainly differ from the latter 2 described species by their body sculpture and color.

#### Acknowledgments

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based on their nineteenth and early twentieth century types.  
*Zootaxa* 2792:68.

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phylogenetic relationships of *Bolivar* gen. nov., a new genus  
of Neotropical doryctine wasps (Braconidae). *Invertebrate  
Systematics* 27:673-688.

**Appendix.** List of the 44 currently recognised species of *Notiospathius*.

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<i>N. araguae</i> López-Estrada and Zaldívar-Riverón	<i>N. laurae</i> sp. n.
<i>N. angustus</i> Marsh	<i>N. leucacrocer</i> (Enderlein)
<i>N. ater</i> De Jesús-Bonilla, Nunes, Pentead-Dias and Zaldívar-Riverón	<i>N. mariachi</i> sp. n.
<i>N. badius</i> Marsh	<i>N. melosus</i> Marsh
<i>N. bicolor</i> Marsh	<i>N. nigra</i> Marsh
<i>N. bisulcatus</i> sp. n.	<i>N. ninae</i> Marsh
<i>N. boharti</i> Marsh	<i>N. novateutoniae</i> De Jesús-Bonilla, Nunes, Pentead-Dias and Zaldívar-Riverón
<i>N. bolivari</i> López-Estrada and Zaldívar-Riverón	<i>N. pauli</i> (Marsh)
<i>N. carolinae</i> (Marsh)	<i>N. platycorsus</i> Marsh
<i>N. caudatus</i> (Szépligeti)	<i>N. rugunotum</i> Marsh
<i>N. chinanteco</i> sp. n.	<i>N. saminae</i> Marsh
<i>N. colombianus</i> (Enderlein)	<i>N. sculpturatus</i> (Enderlein)
<i>N. crypticus</i> sp. n.	<i>N. shawi</i> Marsh
<i>N. curvilineatus</i> López-Estrada and Zaldívar-Riverón	<i>N. sulcatus</i> De Jesús-Bonilla, Nunes, Pentead-Dias, Zaldívar-Riverón
<i>N. dantei</i> López-Estrada and Zaldívar-Riverón	<i>N. striatifrons</i> (Cameron)
<i>N. diversus</i> (Szépligeti).	<i>N. terminalis</i> (Ashmead)
<i>N. eleuther</i> ae (Ashmead)	<i>N. tinclipennis</i> (Cameron)
<i>N. estradae</i> López-Estrada and Zaldívar-Riverón	<i>N. tuxtlaensis</i> sp. n.
<i>N. flavotestaceous</i> (Ashmead)	<i>N. ugaldei</i> Marsh
<i>N. fuscipes</i> (Cameron)	<i>N. venezuelae</i> López-Estrada and Zaldívar-Riverón
<i>N. janzeni</i> Marsh	<i>N. xanthofasciatus</i> De Jesús-Bonilla, Nunes, Pentead-Dias and Zaldívar-Riverón
<i>N. johnlennoni</i> De Jesús-Bonilla, Nunes, Pentead-Dias and Zaldívar-Riverón	
<i>N. larensis</i> López-Estrada and Zaldívar-Riverón	

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