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Three new species of *Neofidelia* (Hymenoptera: Apoidea: Megachilidae) from Northern Chile

SHEILA DUMESH¹ & LAURENCE PACKER²

Department of Biology, York University, 4700 Keele St., Toronto, ON, M3J 1P3, CANADA.

E-mail: ¹mexalictus@outlook.com; ²xeromelissa@mail.com

Abstract

Neofidelia apacheta Dumesh and Packer, **sp. nov.**, *N. camanchaca* Dumesh and Packer, **sp. nov.**, and *N. submersa* Dumesh and Packer, **sp. nov.** are described from northern Chile. *Neofidelia apacheta* is known from large numbers of specimens and localities at moderately high elevation (1600–3200m). *Neofidelia camanchaca* is only known from the holotype male. *Neofidelia submersa* is known from the holotype male and a pair of paratypes in poor condition, all from a coastal fog oasis. Comparisons are made with the two previously described species of the genus. The collection of *N. apacheta* from so far north in Chile suggests that *Neofidelia* is likely to be found in southern Peru. A key for the five species of the genus is provided.

Key words: Atacama Desert, fog oasis, Andes, identification key, monolecy, floral hosts, Solanaceae, *Nolana*

Resumen

Neofidelia apacheta Dumesh y Packer, **sp. nov.**, *N. camanchaca* Dumesh y Packer, **sp. nov.**, y *N. submersa* Dumesh y Packer, **sp. nov.** se describen para el norte de Chile. *Neofidelia apacheta* es conocida por un gran número de ejemplares y localidades de elevación moderadamente alta (1600–3200m). *Neofidelia camanchaca* sólo se conoce por el holotipo macho. *Neofidelia submersa* se conoce por el holotipo macho y por un par de paratipos en mal estado, todos provenientes de un oasis de niebla costera. Se realizan comparaciones con las dos especies previamente descritas del género. La colecta de *N. apacheta* tan al norte en Chile sugiere que *Neofidelia* probablemente se encuentre en el sur de Perú. Se proporciona una clave para las cinco especies del género.

Introduction

Neofidelia profuga Moure and Michener (1955) was described as a new genus and species and was the first record of the bee tribe Fideliini (family Fideliidae at that time) from the New World. Rozen (1970) described a second species, *N. longirostris*. As currently known, the genus is endemic to Chile, with published records from Coquimbo in the south to near Chañaral in the north. It is currently considered to be the sister genus to the remaining Fideliini (Gonzalez et al., 2012) and to belong to its own subtribe, the Neofideliina (Engel, 2004). Here we describe three more species of *Neofidelia*; one collected in large numbers from numerous localities in northern Chile in 2012 and the others from much more restricted material. These records extend the range of the genus 1000km further north than previously indicated in the literature (Rozen, 1970).

Methods

Terminology follows Rozen (1970) and Michener (2007) with the following exceptions. The term metapostnotum is used for what these authors refer to as the dorsal surface of the propodeum and following Prentice (1998) the terms vertexal and frontal areas are used instead of vertex and frons. The male metafemur in *Neofidelia* is swollen

and bears two teeth or angulations towards the apex on the anteroventral margin. These are arranged longitudinally and united by a sharp ridge and are referred to as the subapical and apical teeth (or angles) respectively. Females have a metabasitarsus that has a glabrous dorsal surface with long, erect hairs on either side; the latter are referred to as the metabasitarsal fringe. Sizes of some structures and length of pubescence are given relative to the transverse diameter of the median ocellus—MOD. Puncture density is expressed as interspace relative to puncture diameters (pd). F, S, and T followed by a number refer to flagellomeres and metasomal sterna and terga respectively.

Male terminalia were cleared in 5% KOH for six hours and stored in glycerine except during imaging when they were mounted in KY jelly on a depression slide. Images were taken using using a Visionary Digital BK Plus imaging system fitted with a Canon EOS 40D digital SLR camera and processed with Helicon Focus and Adobe Photoshop ©.

Many specimens of *N. apacheta* were captured using pan traps and deeper cup versions (Creative Converting, Cold Cups, Clintonville, WI), of which dark blue non-fluorescent colours were, by far, the most successful.

Chile is divided into geographical regions that used to be numbered in sequence from north to south except for the region around Santiago (Region Metropolitana). However, the former Region I has recently been divided into a northern Region XV and a more southern, Region I. Thus, the regions of relevance here are, from north to south, XV, I, II, III and IV.

Museum acronyms for institutions housing material under discussion are as follows: AMNH (American Museum of Natural History, New York, USA), PCYU (Packer Collection at York University, Toronto, CANADA), PUCV (Pontificia Universidad de Valparaiso, Valparaiso, CHILE).

Taxonomy

Neofidelia apacheta Dumesh and Packer, new species.

(Figs. 1–2, 3, 6, 7, 10–13, 24, 30)

Diagnosis: For females, the combination of metabasitarsus dorsally concave and laterally curved, and metabasitarsal fringe mostly pale is unique (Figs. 3a and 3b). Other species have the dorsal surface of the metabasitarsus straight in profile (Fig. 4) with the exception of *N. profuga* in which the fringe hairs are brown-black (as they are also in *N. longirostris*) (Fig. 5). For males, the combination of metatibial inner process angulate (Fig. 6) and apex of pygidial plate truncate (Fig. 7) is unique. All other species have a rounded inner process to the metatibia (Fig. 8) except for *N. camanchaca* which has a rounded apex to the pygidial plate (Fig. 9).

Description: Male: Dimensions: Length 9.8–11.3 mm, forewing length 6.3–7.7 mm, head breadth 2.3–2.8 mm, ITW 1.6–1.9 mm.

Colouration: Integument black, except: ventral surface of antenna brown; apex of clypeus and of mandible reddish; malar space with apical reddish-orange spot; tarsi reddish brown; apical impressed areas of terga brown becoming translucent apically; T6 mostly yellow ochre, apex red-brown, base suffused with dark brown.

Pubescence: Hairs mostly pale yellowish white, longest on mesopleuron (6.5MOD), metafemur (4–5MOD), and genal area below (5MOD); pubescence of face most dense on antennal scape, supraclypeal area, and upper third of clypeus; pubescence long and dense on mesosoma except metapleuron below and propodeum anterolaterally; mesotarsus with long hairs (4MOD); metatibia with dense long pubescence on ventral surface (3MOD); T1 with long hairs on disc (4MOD), T1–T7 with long hairs laterally, longest on T5–T7 (3.5MOD), T7 bare on apical half; S1–S5 with long (≤ 3 MOD) suberect hairs laterally, parallel to surface and shorter (< 2 MOD), erect hairs on disc; S6–S7 with dense ventrally oriented hairs (1MOD and 1.7MOD, respectively).

Sculpture: Clypeus coarsely and densely punctate on basal 1/4 (< 1 pd), finely and sparsely punctate on apical 3/4 (3–4pd); supraclypeal area punctures coarse, crowded; metafemur imbricate and densely punctate (< 1 pd), punctures slightly sparser anteroventrally (1–1.5pd); terga with basal areas densely and coarsely punctate (≤ 1 pd), punctures sparser medially (~ 2 pd), medially (~ 2 pd), apical impressed areas shiny and impunctate, T5–T7 slightly more coarsely punctate than other terga; T2 with weak transverse wrinkles on posterior half of disc; pygidial plate imbricate, surface irregularly wrinkled, mostly impunctate except for sparse punctures basally and large punctures along lateral margins; sterna more densely punctate than terga (1–2pd).

Structure: Head broader than long (59:66), clypeus only slightly more protuberant than breadth of compound eye (16:15); labrum 1.3X as long as broad; mouthparts elongate, surpassing procoxa in repose; scape 2X as long as broad, pedicel as long as broad, F1 1.7X as long as broad, F2–F3 broader than long, F4–F5 with length and breadth subequal, F6–F11 longer than broad; mouthparts elongate, labial palpus 1.35X as long as head, glossa and labial palpus subequal in length; mesoscutellum strongly convex; metafemur swollen (L:B 80:45), subapical angle 1/3 femur length from apex, approximately right angular, apical angle 1/6 femur length from apex, clearly obtuse; metatibia apically broadened (L:B 65:24), ventral surface with two longitudinal ridges, outer ridge strongly carinate, inner surface carinate on apical 1/3, both outer and inner ridges with sharp apicoventral angulation 1/4 from apex; pygidial plate enclosed by carina, apex truncate. Genitalia: gonostylus extending slightly beyond apex of penis valve, with translucent area less than 1/2 length of gonostylus (Fig. 10–11); S7 strongly sclerotized medially, apical margin weakly concave and with small apicomedian convexity (Fig. 12); S8 apically rounded (Fig. 13).

Female : As in male except as follows:

Dimensions: Length 7.2–10.6 mm, forewing length 5.1–6.3 mm, head breadth 2.06–2.6 mm, ITW 1.5–2.0 mm.

Colouration: Tarsomeres golden-brown basally, brown apically.

Pubescence: Hairs long on genal area below, profemur, mesotarsus, and sternal scopa (4MOD), longest apicodorsally on metatibia (6MOD) and metabasitarsus (5MOD); metabasitarsus and metatibia with pale brown hairs, those on metatibial fringe darkened towards their apices; on face most dense on supraclypeal area and lower paraocular area; on clypeus less dense than on rest of face, not obscuring surface beneath; on mesosoma shorter on dorsal surfaces, longer on mesopleuron, lower half of metapleuron bare; metabasitarsal fringe long, laterally divergent ~45° from vertical; T1–T5 with long hairs covering terga except apical impressed areas bare; T6 entirely bare.



FIGURES 1–2. Fig. 1. *N. apacheta* male lateral habitus; Fig 2. *N. apacheta* female lateral habitus. Scale bars = 1mm.

Sculpture: Face with punctation very fine, coarsest on upper paraocular area and between lateral ocelli, sparse on vertexal area (2pd), smooth and impunctate between lateral ocellus and compound eye, punctures fine on lower paraocular area (2–3pd), supraclypeal area densely punctate (1pd), clypeus finely and sparsely punctate (3pd) with poorly demarcated impunctate median line, genal area finely punctate (1–2pd); mesoscutum finely and irregularly punctate; mesoscutellum shiny, impunctate on anterior 1/4, elsewhere 1–2pd; mesopleuron with punctures sparser posteriorly and on lower third; lower half of metapleuron impunctate, upper half sparsely punctate (2–4pd); dorsal surface of metabasitarsus shiny and impunctate; lateral surface of propodeum minutely punctate, (1–2pd), posterior surface with some larger, sparser punctures; metasomal terga with basal areas sparsely punctate, apical impressed areas impunctate, T1–T2 finely punctate on discs (4–5pd), punctures sparser but somewhat coarser on T3–T5, pygidial plate coarsely imbricate without conspicuous punctures; sterna more densely punctate (1–2pd), punctures largely hidden below dense scopal hairs.

Structure: Head broader than long (L:B 47:51); clypeus more protuberant than breadth of compound eye (55:50) and apical lip only slightly convex in lateral view; labrum 1.5X as long as broad; antennal scape 2.2X as long as broad, pedicel as long as broad, F1 2X as long as broad, F2–F3 broader than long, F4–F5 about as long as broad, F6–F10 longer than broad; metabasitarsus with outer margin and dorsal surface slightly longitudinally convex, breadth of glabrous dorsal surface ~1/5th as long as the basitarsus, and subequal to MOD (breadth:length:MOD 6:31:6); terga with apical impressed areas triangular, medially occupying almost half length of tergum, narrowing laterally, occupying 1/7th length of tergum.

Material Studied: Holotype male, allotype female, 126 female and 46 male paratypes as follows: Holotype male, allotype female, 3 female and 1 male paratypes: CHILE, Region I, 62km E. of Pozo Almonte, -20.28928 -69.21951. 2464m, 14.iv.2012, L. Packer, *ex Nolana tarapacana*. Additional paratypes, all collected by the junior author, are as follows: same locality as holotype but 15–16.iv.2012, pan and cup traps, 14 females and 2 males; same locality except 21.iv.–10.v.2012, pan and cup traps, 43 females and 8 males. Region I, ~70km E. Pozo Almonte, -20.29732 -69.14223, 2969m, 16–21.iv.2012, L. Packer, pan traps, 3 females and 1 male; Region I, ~73km E. Pozo Almonte, -20.31233 -69.12930, 3137m, 16–21.iv.2012, pan and cup traps, 4 females and 2 males; same locality except 21.v.2012, 1 male *ex Nolana tarapacana*; Region I, Mamigna vertedero, -20.06175 -69.22181, 2660m, 16–21.iv.2012, pan and cup traps, 10 females and 1 male; same locality except 21.iv.–10.v.2012, pan and cup traps, 3 females and 10 males. Region I, 4km NW Mamigna, -20.06371 -69.23058. 2683m, 16–21.iv.2012, pan and cup traps, 20 females and 8 males; same locality except 21.iv.–10.v.2012, 6 females and 8 males; Region I, S. of Cerro Colorado, -20.08888 -69.28450, 2386m, 16–21.iv.2012, pan and cup traps, 1 female and 1 male; same locality except 21.iv.–10.v.2012, pan and cup traps, 7 females and 1 male; Region I, Hwy 31 59km, Pampa de Chaca, -18.73617 -69.75206, 2175m, 20.iv.–11.v.2012, cup trap, 2 females; Region I, Hwy 31 55.6km, Pampa de Chaca -18.74978 -69.78452, 2989m, 20.iv.–11.v.2012, pan traps, 3 females; same locality except 1935m, 19.iv.–12.v.2012, vane trap, 4 females and 1 male; Region XV, Hwy 11 65km, -18.47355 -69.84498, 1935m, 19.iv.–12.v.2012, L. Packer, pan traps, 3 females and 1 male; Region XV, Planta Quiborax, -18.44193 -69.89268, 1660m, 19.iv.–13.v. 2012, L. Packer, pan trap, 1 female.

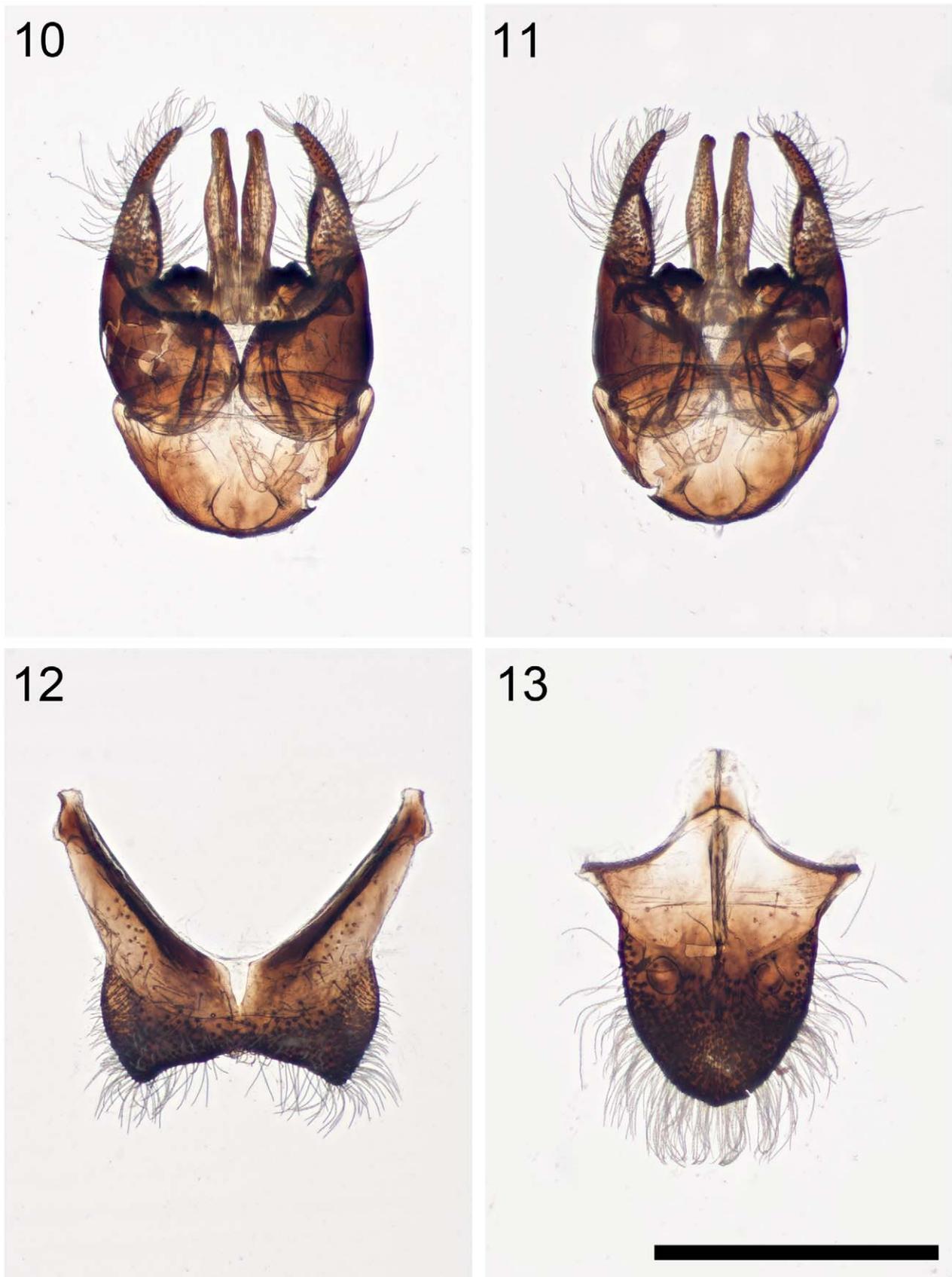
All specimens are housed at PCYU with the exception of two females and one male (Praz-Litman collection, Neuchatel); one female (personal collection of Rolando Humire); two males and five females, including holo- and allotypes (PUCV); one male and one female at AMNH. Paratypes will be sent to various additional museums in due course.

Etymology: The specific epithet refers to the cairn-like piles of stones that the Aymara peoples of northern Chile constructed as part of ritual offerings made by travellers in the hope of a safe journey. Several such “apachetas” are given official archaeological site status in the vicinity of the type locality.

Variation: This species varies considerably in size: the smallest female is slightly more than 2/3 the size of the largest. Males are somewhat less variable in size, with the smallest being 4/5 the size of the largest. None of the important diagnostic features of the species shows clear allometric variation. The colour, sculpture and shape of the female pygidial plate varies: although it is always yellowish for most of its length and coarsely imbricate basally, the extent of yellow varies and some individuals have it smooth and shiny for the apical ¼. The angle subtended by the sides of T6 varies from less than 60° to almost 80°.



FIGURES 3–9. Fig. 3. *N. apacheta* female metabasitarsus in lateral view to show dorsal concavity (3a), in dorsal view to show lateral curvature and pale fringe (3b); Fig. 4. *N. longirostris* female metabasitarsus in lateral view to show dorsal surface straight (4a), in dorsal view to show dorsal surface parallel sided and dark fringe (4b); Fig. 5. *N. profuga* female metabasitarsus to show dorsal surface with weaker longitudinal concavity and dark fringe; Fig. 6. *N. apacheta* male metatibia to show angulate inner process; Fig. 7. *N. apacheta* male pygidial plate to show truncate apex; Fig. 8. *N. longirostris* male metatibia to show rounded inner process; Fig. 9. *N. camanchaca* male pygidial plate to show rounded apex. Scale bars = 1mm.



FIGURES 10–13. Fig. 10. *N. apacheta* genital capsule (dorsal); Fig. 11. *N. apacheta* genital capsule (ventral); Fig. 12. *N. apacheta* S7; Fig. 13. *N. apacheta* S8. Scale bars = 1mm.

Floral hosts: Netted specimens were collected on *Nolana tarapacana* I.M.Johnst. (Solanaceae) and those from pan traps were almost always from areas with abundant flowering plants of this species.

Comments: The discovery of *N. apacheta* is perhaps somewhat surprising as the areas where it was found had been searched by the junior author, also using pan traps, at the same time of year in 2000 and again in 2004 (Genaro and Packer, 2005; Packer, 2005). However, the summer rains (“invierno Boliviano”) were much more plentiful in 2012, in some areas being the strongest in ~30 years (Humire, personal communication) and in others the strongest in over 90 years (Larrain, personal communication). The junior author does not recall seeing *No. tarapacana* in flower during the earlier visits. Other bees not seen in the earlier fieldwork were also discovered abundantly, including an undescribed species of *Xeromelissa* which also seems to specialize upon the flowers of *No. tarapacana*. The known distribution of *No. tarapacana* (Dillon, personal communication) is almost identical to the known localities for *N. apacheta* with the exception that the floral host has also been found at lower elevations (down to 1200m in the Pampa de Tamarugal). While other species of *Neofidelia* are active after winter rain, including the two species described below, *N. apacheta* has only been found after the summer rain which is the main source of precipitation at higher altitudes in the far north of Chile. However, flowering *No. tarapacana* has been collected in October and November and so it is possible that *N. apacheta* may also be found after a rare winter rainfall in the north of Chile.

***Neofidelia camanchaca* Dumesh and Packer, new species**

(Figs. 9, 14, 15, 17–20, 31)

Diagnosis: This species, only known from the male, can be differentiated from others in the genus by the combination of subapical metafemoral angle acute, apical angle strongly obtuse (Fig. 15) and S8 with apicolateral margin weakly concave (see Fig. 20). Other species either have both metafemoral angles acute (*N. profuga* and *N. submersa*, see Fig. 16) or have S8 convex apicolaterally (*N. longirostris* and *N. apacheta*, Fig. 13).

Description: Male. Dimensions: Length 10.5 mm, forewing length 7.7 mm, head breadth 2.9 mm; ITW 2.7 mm. **Colouration:** Integument black, except: ventral surface of antenna brown, scape with apical bright yellow maculation; labrum pale brown; apex of clypeus and mandible reddish, clypeal lip laterally translucent orange; malar space with apical red-orange spot; tarsi red-brown; apical impressed areas of metasomal terga brown; pygidial plate apex red-brown.

Pubescence: Hairs mostly pale whitish, longest on mesopleuron (6MOD), genal area below (5MOD), T2 (5MOD) and mesoscutellum (4.5–5MOD); pubescence of face most dense on scape, supraclypeal area, and upper third of clypeus (3–3.5MOD); pubescence long and dense on mesosoma except lower metapleuron and lateral surface of propodeum anteriorly; mesotarsus with long hairs (4MOD); metafemur with pubescence dense, erect and fine (3.5MOD), metatibia with dense long pubescence on ventral surface (3MOD); T1 with long hairs on disc (4MOD), T2 with long posteriorly oriented hairs (5MOD), T1–T7 with long hairs laterally, longest on T2 and T5–T7 (3.5MOD), T7 bare on apical half; S1–S5 with long (≤ 3.5 MOD) suberect hairs laterally, shorter (< 2 MOD) erect hairs on disc; S6–S7 with dense erect hairs (1MOD and 1.7MOD, respectively).

Sculpture: Supraclypeal area coarsely and densely punctate, punctures crowded; clypeus densely punctate on basal 1/2 (1–2pd), punctures becoming sparser and finer on apical 1/2 (3–4pd), with faint impunctate medial line; metafemur shiny, densely punctate (< 1 pd); metasomal terga with discs densely punctate basally (1–2pd), more sparsely apically (3–4pd), T5–T7 slightly more coarsely punctate than more basal terga, apical impressed areas impunctate; pygidial plate shiny, surface mostly smooth and impunctate except minutely punctate along lateral margins; sterna more densely punctate apically (< 1 pd) than basally (1–2pd), punctures generally smaller on posterior of disc.

Structure: Head broader than long (L:B 50:58), clypeus more protuberant than breadth of compound eye in lateral view (21:18); antennal scape 1.7X as long as broad, pedicel as long as broad, F1 2.7X as long as broad, F2–F3 broader than long, F4–F5 with length and breadth subequal, F6–F11 longer than broad; frontal line narrowly depressed; labrum 1.5X as long as broad; mouthparts elongate, labial palpus 1.5X as long as head, glossa surpassing labial palpus by ~1/10 length (60:67); mesoscutellum strongly convex; metatrochanter triangularly produced mesoventrally, apicomedian angle slightly less than 90°; metafemur swollen (L:B 75:27), subapical angle 1/4 femur length from apex, acute, apical angle obtuse and barely recognisable; metatibia broad (L:B 75:25), outer ridge with sharp apicoventral angulation 1/4 from apex, inner ridge with angulation obtuse and somewhat

outwardly oriented. Genitalia: gonostylus with basal translucent area extending for more than 1/2 of gonostylar length, apex pointed (Fig. 17–18); S7 with apical margin weakly concave; disc almost straight laterally for basal half (Fig. 19); S8 concave apicolaterally, apex truncate (Fig. 20).

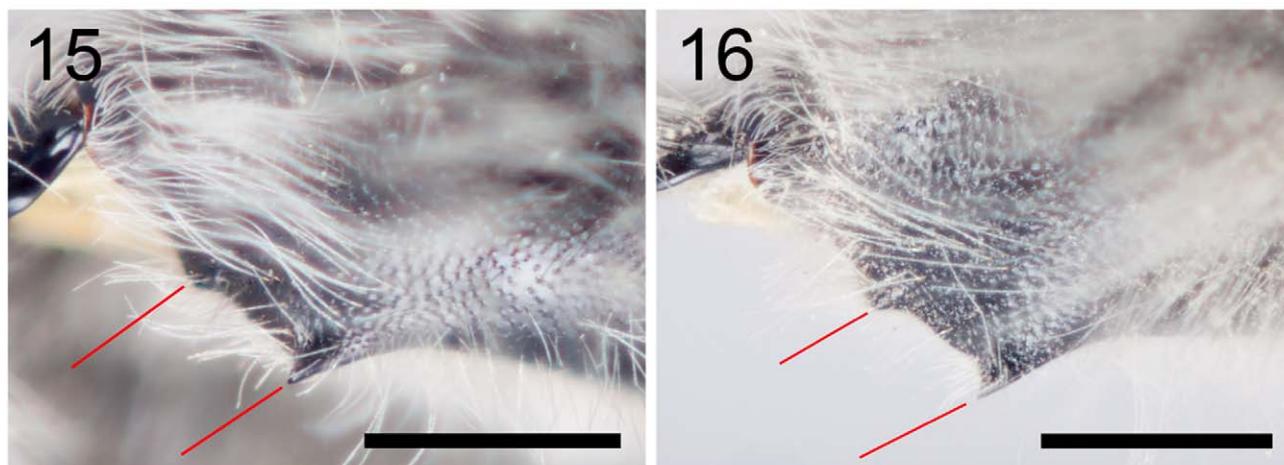
Female. Unknown.

Material Studied: Holotype male: CHILE: Antofagasta, 20–40 km N. Paposo, 28–30.x.1983, Luis E. Peña. The specimen has an additional label with an AMNH_ENT barcode, AMNH_BEE 00009579.

Etymology: The species is named after the Chilean term for coastal fog – “camanchaca”, in reference to the fog that provides much of the moisture along the coast of the Atacama desert.



FIGURE 14. *N. camanchaca* male lateral habitus. Scale bar = 1mm.



FIGURES 15, 16. Fig. 15. *N. camanchaca* male metafemoral spines to show subapical angle acute, apical angle strongly obtuse; Fig. 16. *N. submersa* male metafemoral spines to show subapical angle acute and apical angle right angular to acute. Scale bars = 1mm.



FIGURES 17–20. Fig.17. *N. camanchaca* genital capsule (dorsal); Fig. 18. *N. camanchaca* genital capsule (ventral); Fig. 19. *N. camanchaca* S7; Fig. 20. *N. camanchaca* S8. Scale bars = 1mm.

***Neofidelia submersa* Dumesh and Packer, new species.**

(Figs. 16, 21–23, 25–28)

Diagnosis: Both sexes can be differentiated from all other species in the genus by the more strongly produced clypeus which extends in front of the anterior tangent of the compound eye by substantially more than the eye's breadth ($>1.3X$) (Fig. 23). Other species have the clypeus protruding at most $1.1X$ the breadth of the compound eye (Fig. 24).

Description: Male: *Dimensions:* Length 12.5 mm, forewing length 9.0 mm, head breadth 3.2 mm, ITW 2.7 mm.

Colouration: Integument black, except: ventral surface of antenna brown, F7–F11 ventrally yellowish brown; labrum pale brown on apical 3/4; apex of clypeus and mandible reddish, clypeal lip laterally translucent reddish; malar space with apical red-orange spot; apices of tarsomeres orange-brown; apical impressed areas of terga brown, with apical translucent rim; pygidial plate apex red-brown.

Pubescence: Hairs mostly pale whitish, longest on gena below (5MOD); long on mesopleuron, scape, supraclypeal area, upper third of clypeus, mesoscutellum and T2 (3.5MOD); on face most dense on antennal scape, supraclypeal area, and upper third of clypeus; long and dense on mesosoma except lower metapleuron and lateral surface of propodeum anteriorly; mesotarsus with long hairs (4MOD); metafemur with hairs dense, erect, fine (3MOD) and largely obscuring surface; metatibia with dense long hairs on ventral surface (2.5MOD), sparse long hairs on outer surface (3.5MOD); T2 with long suberect hairs on basal 1/3, posteriorly oriented hairs on apical 2/3 (3MOD), T1–T7 with long hairs laterally, longest on T2 and T5–T7 (3MOD), T7 bare on apical half; S1–S5 with long ($\leq 3MOD$) suberect hairs laterally, shorter ($< 2MOD$), erect hairs on disc; S6–S7 with dense ventrally oriented hairs (1MOD and 0.7MOD, respectively).

Sculpture: Supraclypeal area coarsely and densely punctate, punctures crowded; clypeus densely punctate throughout (1–2pd), with shiny, slightly raised impunctate medial line on apical 1/2; frontal line broadly depressed and shiny; metafemur densely punctate ($\leq 1pd$ except antero- and posteroventrally); metasomal terga with basal areas punctate (1–2pd), sparser medially; apical impressed areas impunctate; T5–T7 slightly more coarsely punctate than more basal terga; pygidial plate shiny, surface very weakly wrinkled with obscure punctures on lateral margins; sterna more densely punctate apically ($< 1pd$) than basally (1–2pd), punctures generally smaller on posterior of disc.

Structure: Head broader than long (L:B 57:62), clypeus more protuberant than breadth of compound eye in lateral view (22:17); antennal scape 2X as long as broad, pedicel as long as broad, F1 2.4X as long as broad, F2–F3 broader than long, F4–F5 with length and breadth subequal, F6–F11 longer than broad; labrum 1.7X as long as broad; mouthparts elongate, labial palpus 1.4X as long as head, glossa no longer than length of labial palpus; mesoscutellum strongly convex; metafemur swollen (L:B 69:45), subapical angle 1/4 femur length from apex, acute, apical angle right angular to acute; metatibia broad (L:B 82:32), outer ridge with sharp apicoventral angulation 1/4 from apex, inner ridge rounded, in lateral view. Genitalia: gonostylus with translucent area extending for about 1/2 length, apex rounded (Fig. 25–26); S7 with sides of disc comparatively straight for basal half (Fig. 27); S8 weakly concave apicolaterally, apex subtruncate (Fig. 28).

Female. As in male except as follows:

Dimensions: Body length incalculable as sole specimen lacks a metasoma, estimated to be 12.3–12.7 mm, forewing length 7.2 mm, head breadth 3.2 mm, ITW 2.6 mm.

Colouration: Tarsomeres golden orange basally, except apical tarsomere brown.

Pubescence: Hairs pale whitish-grey, somewhat yellowish on frontal area and mesosoma, pale brown on legs except darker on hind leg. Long on supraclypeal area, genal area below, forefemur, and midtarsus (3MOD), longest dorsally at midlength of metatibia (4.5MOD); pubescence of face most dense on supraclypeal and lower paraocular areas; pubescence of clypeus less dense than on rest of face, not obstructing surface beneath; pubescence of mesosoma shorter on dorsal surface ($\leq 2MOD$ except 2.5MOD on metanotum), longer on mesopleuron ($\sim 3MOD$), lower half of metapleuron bare; dorsal surface of hind basitarsus bare, fringe long (3.5MOD) and erect, pale brown.

Sculpture: Face with punctuation fine, most dense on supraclypeal and lower paraocular areas ($\sim 1pd$), less dense on upper paraocular area and between lateral ocelli (1–2pd), smooth and impunctate between lateral ocellus and compound eye; clypeus with punctures irregular in size and spacing (1–4pd) with poorly demarcated impunctate, somewhat raised median line; genal area finely punctate (1–3pd); mesoscutum finely punctate (1–1.5pd), mesoscutellum with larger punctures ($\sim 1pd$ except sparser anteriorly), mesopleuron densely punctate ($\sim 1pd$) somewhat more sparsely posteriorly and below (1–3pd), lower half of metapleuron with few scattered punctures; metapostnotum transversely striate anteriorly, imbricate otherwise; lateral surface of propodeum with large punctures (1–2pd) except with sparse, small punctures below; dorsal surface of metatarsus shiny and impunctate.

Structure: Head broader than long (L:B 44:50); antennal scape 2.5X as long as broad, pedicel as long as broad, F1 2X as long as broad; clypeus strongly protuberant, produced for more than breadth of compound eye in lateral view (40:36), apex weakly concave medially, apical lip only slightly convex in lateral view; labrum almost 1.5X as long as broad (34:24); mouthparts elongate, surpassing procoxa in repose; metabasitarsus slender and parallel sided, breadth much less than MOD (breadth:length:MOD 5:50:8).

Material Studied: Holotype male: CHILE: Region I, Alto Patache xi.1997, W. Sielfeld, allotype female: CHILE, Region I, Alto Patache, 800m, 26.x.2001, H. Larrain; the underside of the label reads "Ahogada recip. agua" which means "dead in the water container" (Larrain, personal communication); same locality and collector as allotype except 750m, x.2002, "trampa canadiense" (which refers to a malaise trap the junior author sent to Dr. Larrain), one paratype male. The female allotype is missing both antennae (except for the left scape and pedicel), the right midleg, the left mesopretarsus, the left hindleg beyond the trochanter, the apical three right metatarsomeres and the metasoma. The male paratype exists only as a mesosoma missing the left front and hind legs.

Etymology: The species is named after the latin for "to drown", as the sole female was caught drowned in water.

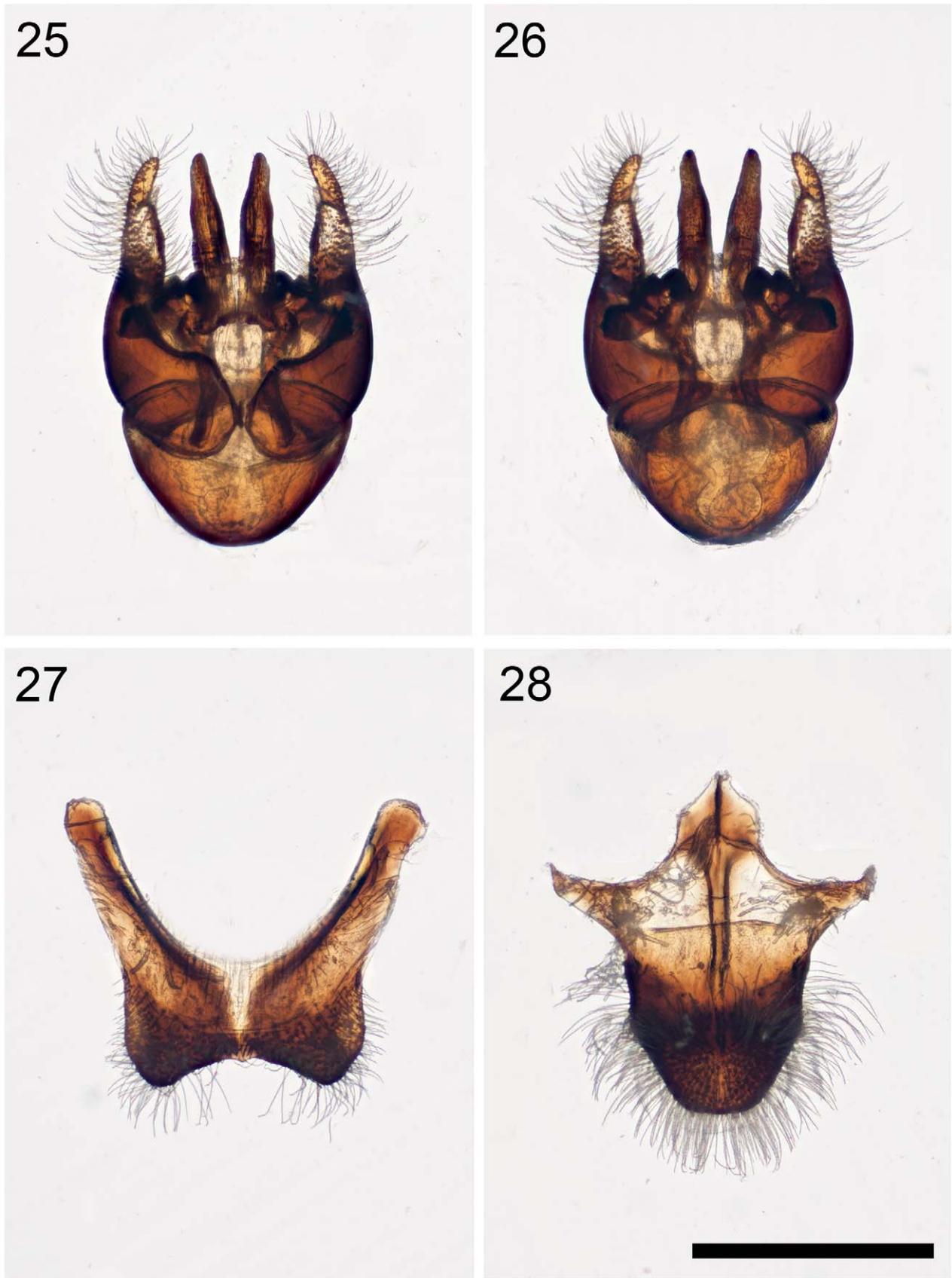
Comments: *Neofidelia submersa* is known only from a fog oasis south of Iquique. Alto Patache is at 20°49'S, 70°09'W (Sagredo *et al.*, 2002; in decimal degrees this is -20.8167, -70.1500) and is a cool and comparatively damp locality surrounded to the north, south and east by inhospitable desert and to the west by the Pacific Ocean. It is one of a series of fog oases along the coast of Chile and southern Peru which are known for their high levels of endemism for plants (Muñoz-Schick *et al.*, 2001) and presumably also for bees. Packer (2012, see also references therein) provided some details on the environment at this locality.



FIGURES 21, 22. Fig. 21. *N. submersa* male lateral habitus; Fig. 22. *N. submersa* female lateral habitus. Scale bars = 1mm.



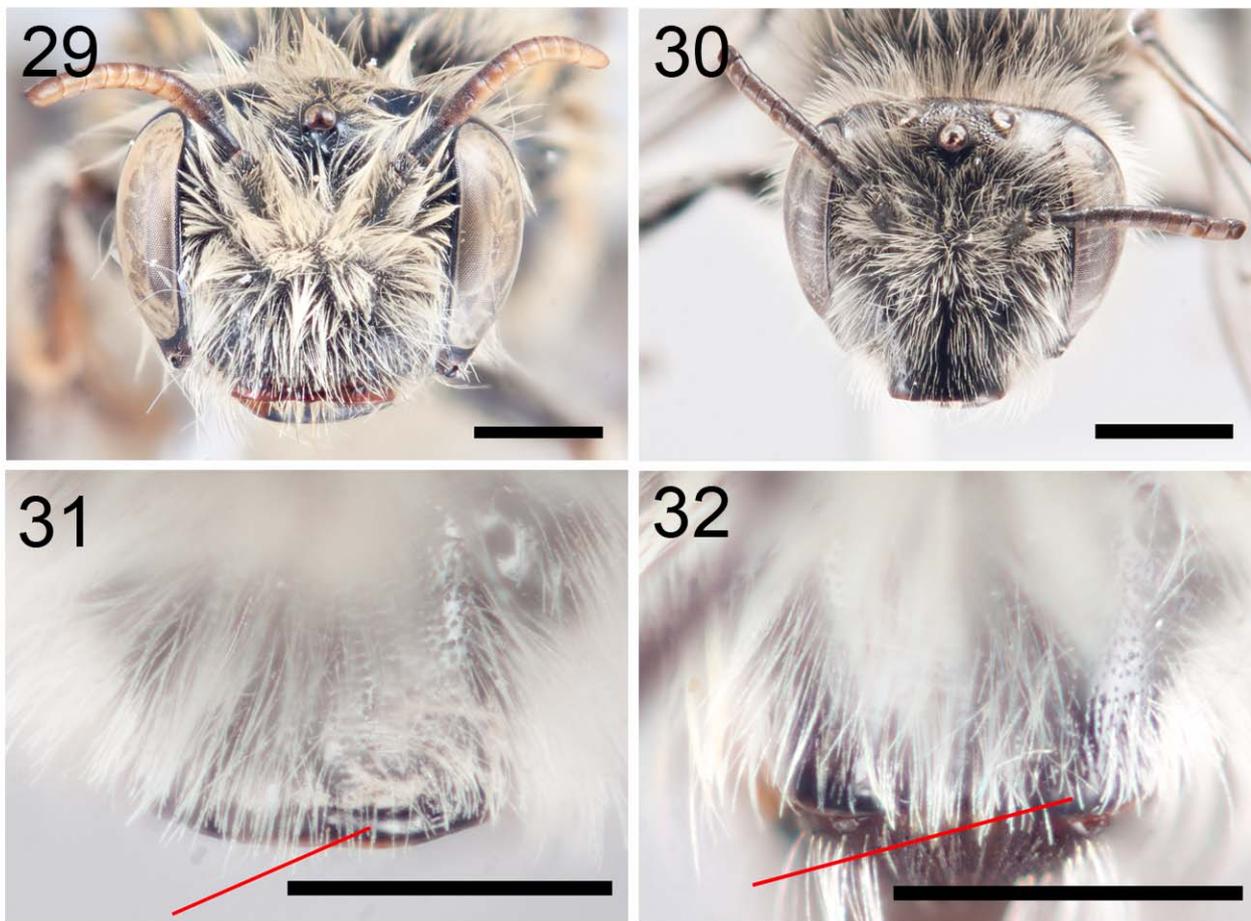
FIGURES 23, 24. Fig. 23. *N. submersa* female side view of head to show strong protuberance of clypeus; Fig. 24. *N. apacheta* female side view of head to show weaker protuberance of clypeus. Scale bars = 1mm.



FIGURES 25–28. Fig. 25. *N. submersa* genital capsule (dorsal); Fig. 26. *N. submersa* genital capsule (ventral); Fig. 27. *N. submersa* S7; Fig. 28. *N. submersa* S8. Scale bars = 1mm.

Key to *Neofidelia* species

1. Head clearly broader than long (at least 1.25X as broad as long), clypeus extending at most 1.5–1.8MOD below lower ocular tangent (Fig. 29) (southern Atacama desert, low elevation) *N. profuga* Moure and Michener
Head about as long as broad (1–1.1X as broad as long), clypeus extending at least 2.5MOD below lower ocular tangent (Fig. 30) 2
2. Clypeus produced in front of compound eye by >1.3X the breadth of the compound eye (Fig. 23) (coastal fog oasis habitat in northern Chile) 3
Clypeus produced in front of compound eye by a distance at most subequal to (<1.1X) the breadth of the compound eye (Fig. 24) 4
3. Clypeal lip thick, produced above level of rest of clypeus (Fig 31); metafemur with apical angle right angular to slightly acute (Fig. 16) *N. submersa* Dumesh and Packer
Clypeal lip not produced, evenly leveled with rest of clypeus (Fig 32); metafemur with apical angle strongly obtuse (Fig. 15) *N. camanchaca* Dumesh and Packer
4. Male metatibia with inner angulation sharp (Fig. 6) and pygidial plate with apex truncate (Fig. 7); female metabasitarsus with glabrous dorsal surface laterally curved and broad, 1/5 as broad as long (Fig. 3b) *N. apacheta* Dumesh and Packer
Male metatibia with inner angulation rounded (Fig. 8) and pygidial plate with apex rounded (Fig. 9); female metabasitarsus with glabrous dorsal surface parallel sided and narrow, <1/7 as broad as long (Fig. 4b). *N. longirostris* Rozen



FIGURES 29–33. Fig. 29. *N. profuga* head to show clypeus extending only slightly below lower ocular tangent; Fig. 30. *N. apacheta* head to show clypeus extending further below lower ocular tangent; Fig. 31. *N. submersa* male clypeus to show protuberant clypeal lip; Fig. 32. *N. camanchaca* male clypeus to show non-protuberant clypeal lip. Scale bars = 1mm.

¹ Although the female of *N. camanchaca* is unknown, sexual dimorphism in the protuberance of the clypeal lip is not expected and so this characteristic is likely to work for both sexes.

Discussion

The genus *Neofidelia* was previously known to occur from Coquimbo (Region IV) to around Chañaral (Region III) (Rozen, 1970). The discovery of *N. apacheta* extends the range of the genus further north by 1000km and suggests the possibility that it may occur in southern Peru, the border being less than 40km from some of the paratype localities in Region XV.

While not known with certainty, the capture of *N. apacheta* only on the flowers of, or in close proximity to flowers of, *No. tarapacana*, is suggestive of possible monolecty on this floral host, or oligolecty on it and related *Nolana* species. The lack of specimens prior to 2012, when the same area was searched at times when this plant seems not to have been in bloom, further supports this suggestion. *Neofidelia longirostris* also seems to be a specialist on *Nolana*, but in this instance *N. rostrata* (Lindl.) Miers ex Dunal (Rozen, 1970, as *Alona rostrata*). Floral hosts of *N. submersa* and *N. camanchaca* are unknown, although four species of *Nolana* and almost 40 additional flowering plant species are known from the type locality of the former (Muñoz-Schick et al., 2001) and one *Nolana* species, *N. jaffueli* I.M.Johnst., can be abundant in years when there is rain at Alto Patache (Larrain, personal communication; Packer 2012).

The collection of such a large number of specimens of one of the new species from so many different localities is mostly due to the deployment of pan and cup traps. Most of the localities were also surveyed visually with sampling by net; however, *N. apacheta* was only seen in flight at three but was caught in pan traps at nine. The success of this method is further supported by the capture of this new species in conjunction with two other undescribed bees at multiple sites sometimes with the use of only 1–4 pans.

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