



A new species of *Polypedilum* Kieffer from bromeliads in Parque Nacional Cusuco, Honduras (Chironomidae: Chironominae)

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Abstract

Polypedilum (*P.*) *panacu* sp. n. is described and illustrated based on all life-stages. The larva was collected from the leaf-axils of the bromeliad *Tillandsia guatemalensis* L.B. Smith in Cusuco National Park, Honduras and reared in the laboratory. The male of the new species can be separated from the remaining Neotropical *Polypedilum* s. str. species by the spotted wings combined with the shape of the superior volsella and the number of setae on tergite IX; the female by the two dark spots on the anal part of the wings; the pupae on the presence of spinules on conjunctives III–IV, IV–V and V–VI and the larva on the shape of mentum and pecten epipharyngis.

Key words: Diptera, Chironomidae, *Polypedilum*, Neotropics, Honduras, Cusuco National Park, new species, phytotelmata, bromeliad

Introduction

One of the characteristic features of the exuberant Neotropical forests is the bromeliads. This diverse plant family contains species of all sizes adapted to a wide range of environmental conditions (Benzing 1980). The family is confined to the Neotropical Region with about 2600 species except for *Pitcairnia feliciana* (A.Chev.) Harms & Mildbr. which apparently have reached West Africa by long distance dispersal (Givnish *et al.* 2004). Numerous species of bromeliads are able to hold water in their central tube- or funnel-shaped tank of tightly overlapping leaves. These plant held water bodies or phytotelmata generally house complex communities of aquatic animals, ranging from protozoans to vertebrates (Picado 1913; Frank 1983; Frank & Lounibos 2009). Although these habitats always capture the attention for their potential as breeding sites for human relevant vector bearing mosquitoes or their highly specialized fauna, they are largely understudied and still house a wide variety of undiscovered organisms. During a biodiversity survey of the bromeliad inhabiting fauna in Parque Nacional Cusuco, Honduras, several chironomid species were collected, among them a new species of *Polypedilum* Kieffer, 1912.

The genus *Polypedilum* is one of the most species-rich and widespread genera of chironomids. Eight subgenera of *Polypedilum* are recognized including the subgenus *Probolum* Sæther *et* Andersen recently described based on a species from bromeliads in southern Brazil (Sæther *et al.* 2010). The larvae occur in virtually all standing and flowing waters and several species are known from phytotelmata (see *e.g.* Sæther *et al.* 2010). More than 65 named species of *Polypedilum* are known to occur in the Neotropical Region (Spies & Reiss 1996; Oyewo & Sæther 2008; Donato & Paggi 2008; Sæther *et al.* 2010), of which only *P. corniger* Sublette *et* Sasa (1994: 44), *P. parthenogeneticum* Donato *et* Paggi, 2008: 52, *P. titicacacae* Roback *et* Coffman (1983: 61), *P. umayo* Roback *et* Coffman (1983: 63), and *P. villacanota* Roback *et* Coffman (1983: 59) have been described based on all life stages. According to Spies *et al.* (2009), eleven named species of *Polypedilum* are recorded from Central America. Below we describe all life stages of *P. panacu* n. sp., a bromeliad dweller collected in The Parque Nacional Cusuco in Honduras belonging to the nominal subgenus.

Locality. The material was collected during an expedition organized by Operation Wallacea to Parque Nacional Cusuco (PANACU) in July 2008. The Park is situated in north-western Honduras, within The Merendon Mountain range and consists of a boundary and a core zone with an altitude range from 20 to 2,244 meters above sea level. In the core zone a mixture of primary and secondary lower montane tropical rain forest is found, with patches of primary cloud forest and upper montane rain forest that are characterized by high densities of bromeliads (Wilson & McCranie 2003). Climate data has been extracted from a global dataset available from www.worldclim.org; the protocol used to generate the global dataset is described in Hijmans *et al.* (2005). The data are the result of a spatial interpolation of weather station observations for the period 1950–2000 and we used a mask in GRASS GIS (6.4.1) to calculate statistics for climatic variables above 1,500 meter altitude in Cusuco National Park. The mean annual temperature is $14.5 \pm 0.9^\circ\text{C}$, with minimum 12.8°C and maximum 16.7°C . The maximum temperature of the warmest month of the year over the considered period is $21.1 \pm 1.0^\circ\text{C}$ with a minimum of 19.0°C and a maximum of 23.6°C . The minimum of the coldest month period is $8.3 \pm 0.8^\circ\text{C}$ with the minimum 6.7°C and the maximum 10.5°C . The average annual precipitation is $1,832.1 \pm 56.3$ mm with minimum 1,711 mm and maximum 1,965 mm precipitation.

Material and methods

Larvae were collected from the leaf-axils of the bromeliad *Tillandsia guatemalensis* L. B. Sm. and reared in individual containers in the laboratory (see Mendes 2002). The larval and pupal skins and the emerging adults were preserved in 70% ethanol and later mounted on slides using Euparal as mountant following the procedures outlined by Sæther (1969). The general morphology follows Sæther (1980). Measurements are given as ranges; seta counts on wings are from both sides combined.

All types are deposited in the Department of Natural History, Bergen Museum, University of Bergen, Bergen, Norway (ZMBN).

Polypedilum panacu sp. n.

(Figs 1–22)

Type material. Holotype male with larval and pupal exuviae. **HONDURAS:** San Pedro Sula, Parque Nacional Cusuco (PANACU), close to Operation Wallacea's base camp, $15^\circ32'\text{N}$ $88^\circ15'\text{W}$, vii.2008, in *Tillandsia guatemalensis*, H.F. Mendes & M. Jocqué (ZMBN Type No. 447 (PAN 01)). Allotype female with pupal exuviae: as holotype except (TG-4). Paratypes: 1 male with pupal exuviae, as holotype except (TG-2); 1 female with pupal exuviae, as holotype except (TG-8).

Diagnostic characters. The spotted wings combined with the shape of the superior volsella and the number of setae on tergite IX will separate the male from all other Neotropical *Polypedilum* s. str. species. The female can also be recognized on the two dark spots on the anal part of the wings. The pupae can be readily separated from other described Neotropical species on the presence of spinules on conjunctives III–IV, IV–V and V–VI; the larva on the shape of mentum and pecten epipharyngis.

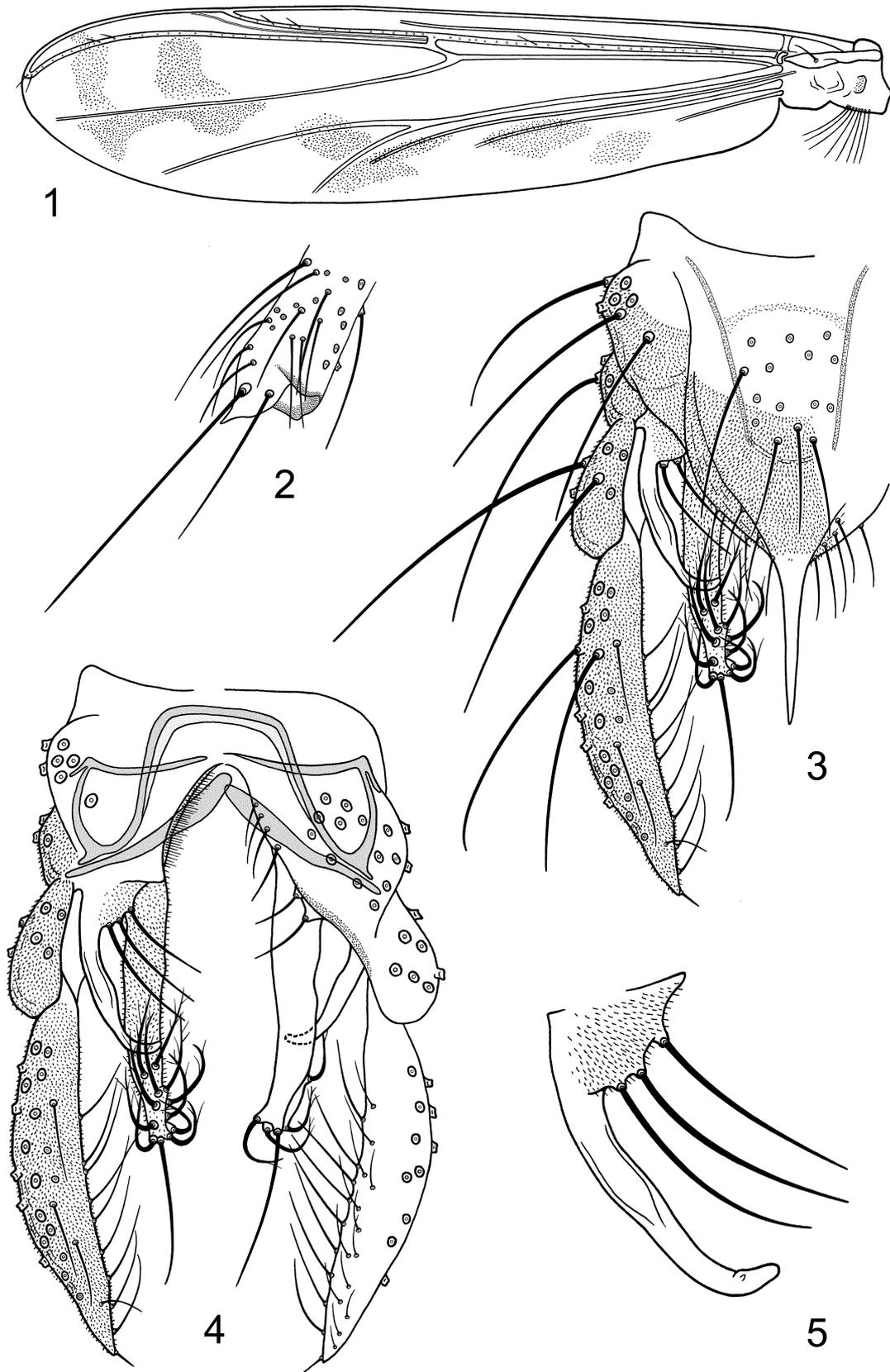
Etymology. From "PANACU", the abbreviation for Parque Nacional Cusuco, San Pedro Sula, Honduras, the type locality of the species. The name is to be treated as a noun in apposition.

Male (n = 1–2). Total length not measurable. Wing length 2.06–2.22 mm. Wing length / length of profemur 1.98–2.14.

Coloration. Body, head and antennae dark brown; legs light brown with darker rings subapically on all femora; wing with dark spots.

Head. AR 1.09. Ultimate flagellomere 534 μm long. Temporal setae 12–13 composed of 5 inner verticals, 3 outer verticals, and 4–5 postorbitals. Clypeus with 27–41 setae. Tentorium 141–143 μm long, 23–24 μm wide; stipes 134–136 μm long, 43–45 μm wide. Palp segment lengths (in μm): 45–58, 41–47, 129–138, 145–150, 177–225. Apex of third palpomere with 3–4 sensilla, longest 27–29 μm long.

Thorax. Acrostichals 13–19, biserial; dorsocentrals 15–16; prealars 6–11, uniserial to biserial; humerals 2–3. Scutellum with 10–12 setae, irregularly biserial.



FIGURES 1–5. *Polypedilum panacu* sp. n., male. 1—wing; 2—scale and spur of fore leg; 3—hypopygium, dorsal view; 4—hypopygium with anal point and tergite IX removed, dorsal aspect to the left and ventral aspect to the right; 5—superior volsella, dorsal view.

Wing (Fig. 1). VR 1.13–1.22. R₂₊₃ ends close to where R₁ meets Sc, R₄₊₅ ending at apex of wing. Brachiolum with 1–2 setae, R with 26–31, R₁ with 13–17, R₄₊₅ with 23–27 setae. Squama with 8–9 setae.

Legs. Scale of fore tibia 48–52 µm long, including 7–9 µm long spur (Fig. 2); spur of mid tibia 57–61 µm long; spur of hind tibia 73–75 µm long. Unspurred comb of mid tibia 25–27 µm long, of hind tibia 26–29 µm long. Apex of fore tibia 63–68 µm wide, of mid tibia 54–66 µm wide, of hind tibia 73–75 µm wide. Length and proportions of legs as in Table 1.

TABLE 1. Length (in µm) and proportions of legs of *Polypedilum panacu* sp. n., male (n = 2).

	fe	ti	ta ₁	ta ₂	ta ₃	ta ₄
p ₁	1087–1142	847–875	1151–1216	728–820	525–589	396–433
p ₂	1160–1207	921–985	617–630	341–359	226–254	143–166
p ₃	1317–1209	1041–1068	870–912	479–497	410–442	249–276
	ta ₅	LR	BV	SV	BR	
p ₁	147–166	0.64–0.67	3.35–3.45	3.37–3.47	4.4–4.8	
p ₂	64–74	0.79–0.84	2.64–2.65	2.71–2.87	5.3–6.3	
p ₃	83–92	0.64–0.67	3.35–3.45	3.37–3.47	4.4–4.8	

Hypopygium (Figs 3–5). Anal point 93–98 µm long, 20–23 µm wide at base, 3–4 µm wide at apex. Tergite IX with 15–16 setae medially and 16–19 setae at base of anal point of which 10–11 strong dorsally, remaining weaker ventrally. Phallapodeme 113–123 µm long; transverse sternapodeme 73–75 µm long. Gonocoxite 185–186 µm long. Superior volsella curved, lacking strong lateral seta, 102–11 µm long, 28–36 µm wide at base, 4–5 µm wide at apex, with 3 strong setae on base. Inferior volsella digitiform 138–143 µm long, 25–27 µm wide at base, 13–16 µm wide at apex, with 8–12 split setae subapically and one stout seta at apex. Gonostylus 198–236 µm long. HR 0.79–0.93.

Female (n = 1–2). Total length not measurable. Wing length 2.04–2.38 mm. Wing length / length of profemur 1.68–1.79.

Coloration. As in male.

Head. AR 0.38. Flagellomere length / width (in µm): 188–197 / 41–43, 118–129 / 36–39, 127 / 34, 75 / 29, 195 / 25. Temporal setae 15–19 composed of 8–9 inner verticals, 3–5 outer verticals, and 4–5 postorbitals. Clypeus with 38–43 setae. Tentorium 136–174 µm long, 24–25 µm wide; stipes 149–150 µm long, 50 µm wide. Palp segment lengths (in µm): 41–52, 43–57, 102, 147, 168. Apex of third palpomere with 9 sensilla, longest about 20 µm long.

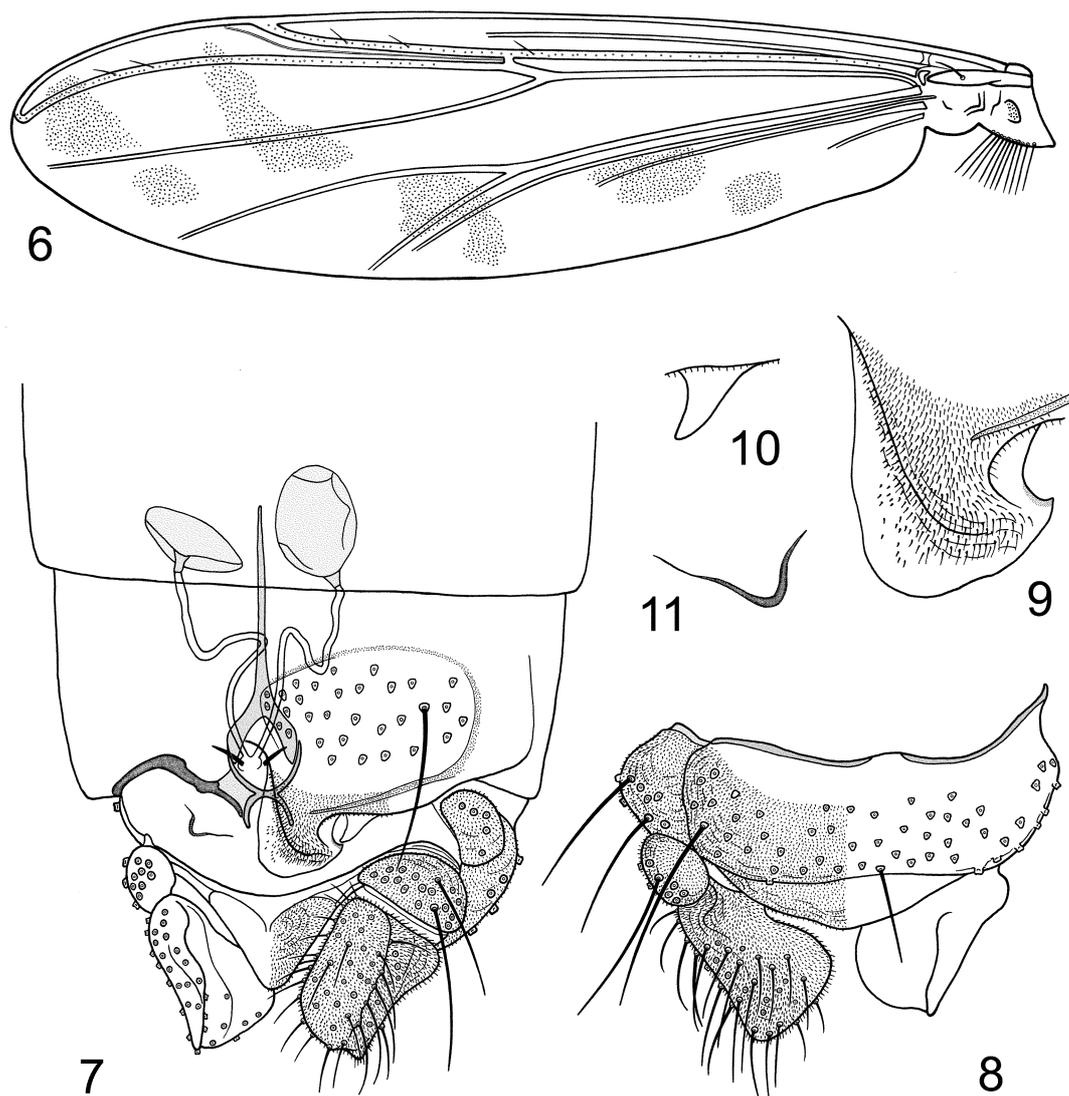
Thorax. Acrostichals 20–23, biserial; dorsocentrals 21–38, irregularly triserial; prealars 13–17, triserial; humerals 4–6. Scutellum with 15–17 setae, irregularly biserial.

Wing (Fig. 6). VR 1.13–1.28. R₂₊₃ ends close to where R₁ meets Sc, R₄₊₅ ending at apex of wing. Brachiolum with 1–2 setae, R with 33–37, R₁ with 25–28, R₄₊₅ with 58–62 setae. Squama with 8–11 setae.

Legs. Scale of fore tibia 52–55 µm long, including 11–14 µm long spur; spur of mid tibia 54–59 µm long; spur of hind tibia 68–77 µm long. Unspurred comb of mid tibia 25–27 µm long, of hind tibia 24–27 µm long. Apex of fore tibia 73–75 µm wide, of mid tibia 73–75 µm wide, of hind tibia 77–82 µm wide. Length and proportions of legs as in Table 2.

TABLE 2. Length (in µm) and proportions of legs of *Polypedilum panacu* sp. n., female (n = 1–2).

	fe	ti	ta ₁	ta ₂	ta ₃	ta ₄
p ₁	1207–1326	893–995	1308	866	617	488
p ₂	1179–1400	1032–1050	672–682	350–396	276–286	175
p ₃	1455–1575	1160–1197	912–1013	543–553	396–488	286–295
	ta ₅	LR	BV	SV	BR	
p ₁	167	1.31	1.70	1.77	–	
p ₂	73–74	0.65	3.29–3.37	3.29–3.59	3.5	
p ₃	110–111	0.79–0.85	2.62–2.64	2.74–2.87	5.3	



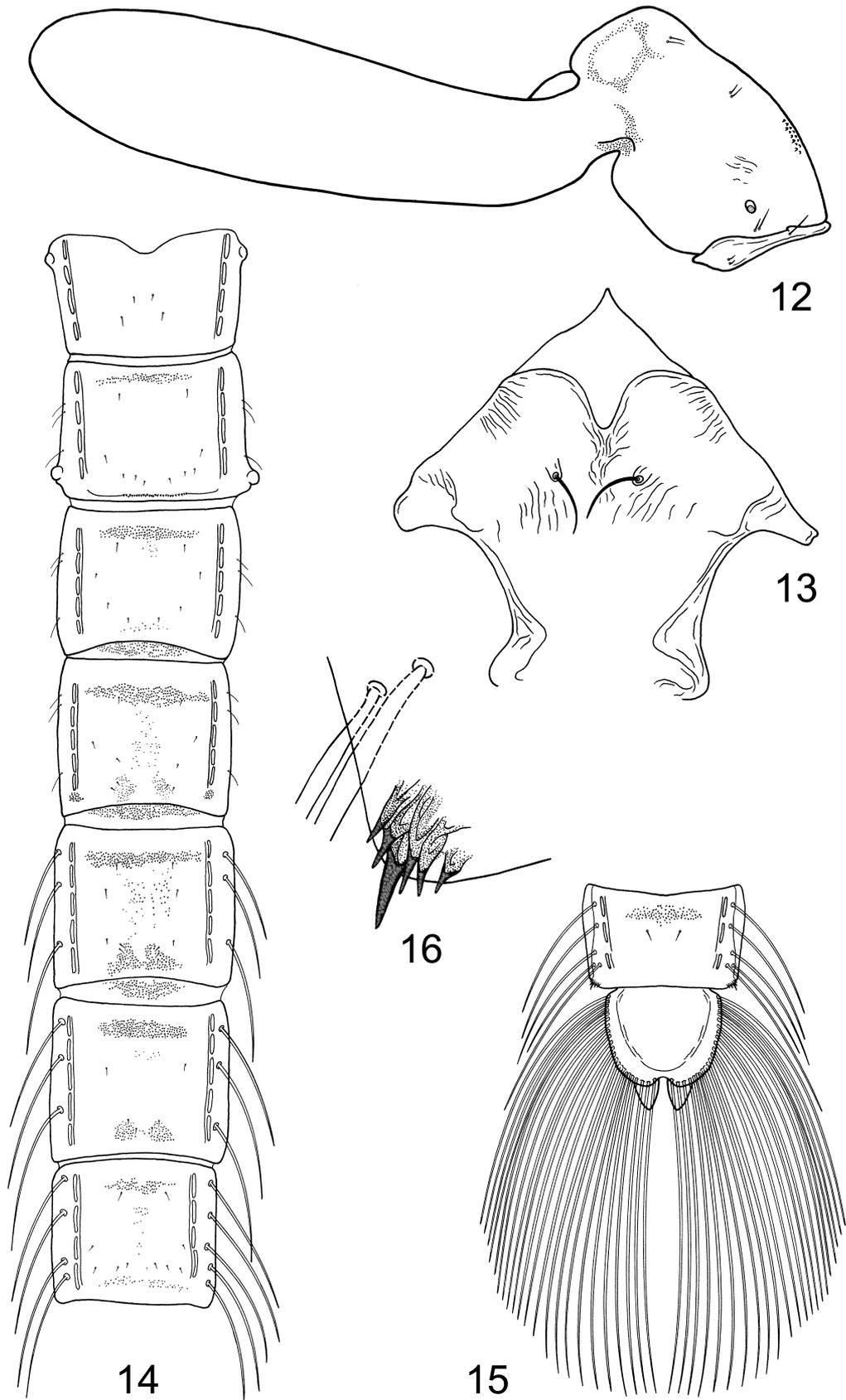
FIGURES 6–11. *Polypedilum panacu* sp. n., female. 6—wing; 7—genitalia, ventral view; 8—genitalia, dorsal view; 9—ventrolateral lobe; 10—dorsomesal lobe; 11—apodeme lobe.

Genitalia (Figs 7–11). Gonocoxapodeme with main branch on dorsomesal lobe, with distinct connection anterior of vagina. Gonocoxite IX with 3–6 strong setae, 57 μm long. Tergite IX with 46–62 setae. Segment X with 12–18 setae to each side. Cercus 111–116 μm long, 141 μm wide. Seminal capsule ovoid, 95 μm long, including 11–14 μm long neck, 4–6 μm wide at the apex. Notum 168–195 μm long. Dorsomesal lobe 104–107 μm long from base of vagina to apex, 54 μm wide at its widest point. Ventrolateral lobe tapering, 30 μm long, 16 μm wide at base, without microtrichia.

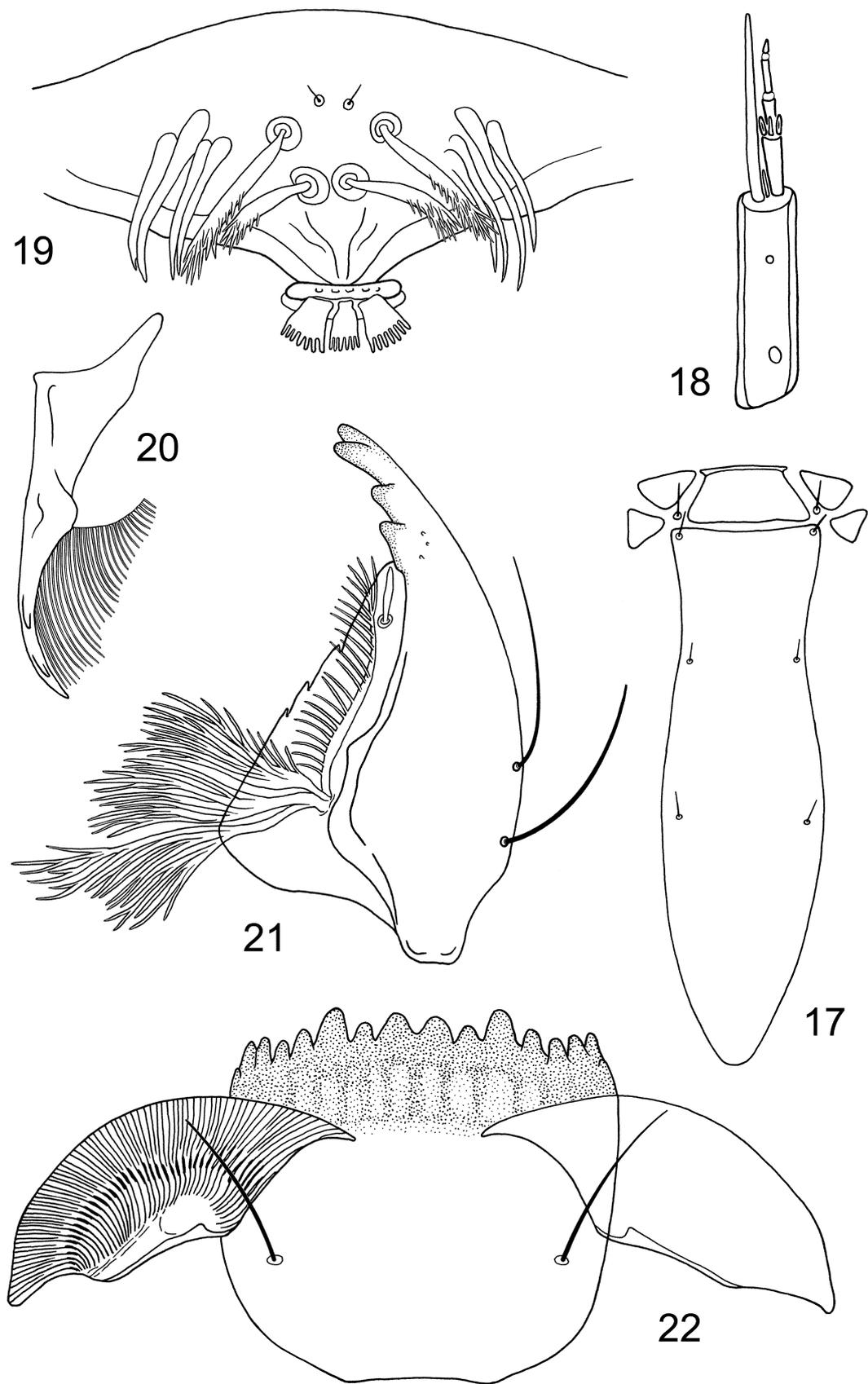
Pupal exuviae ($n = 1-2$). Total length 5.31–6.02 mm.

Coloration. Exuviae translucent; antennal sheaths, oral parts of thorax, wing, and leg sheaths as well as pleurae on abdomen light brown; posterior part of thorax with darker brown patches.

Cephalothorax (Fig. 12). Frontal apotome smooth, frontal setae 41–48 μm long (Fig. 13). Antennal sheaths smooth. Thoracic horn with 8 filaments; basal ring oval, 47–58 μm long, 29–32 μm wide. Scutum with field of few weak tubercles. Anteprenotals 3, median 95 μm long, lateral 40–44 μm long. Precorneals 2, 90–97 and 43–47 μm long. Dorsocentrals 4, Dc₁ 42–46 μm long, Dc₂ 50–61 μm long, Dc₃ 40–41 μm long, and Dc₄ 58–65 μm long; Dc₁ and Dc₂, and Dc₃ and Dc₄ grouped, Dc₁ 9–23 μm in front of Dc₂, Dc₂ 212–239 μm in front of Dc₃, Dc₃ 9–11 μm in front of Dc₄. Prealar absent.



FIGURES 12–16. *Polypedilum panacu* sp. n., pupa. 12—thorax and wing sheath; 13—frontal apotome; 14—tergites I–VII, 15—tergite VIII and anal lobe; 16—anal comb.



FIGURES 17–22. *Polypedilum panacu* sp. n., larva. 17—dorsal sclerites of head; 18—antenna; 19—labro-epipharyngeal region; 20—premandible; 21—mandible; 22—mentum and ventromental plates.



FIGURE 23. The bromeliad *Tillandsia guatemalensis* L. B. Smith is an epiphyte in the cloud forest in Parque Nacional Cusuco, Honduras (photo Merlijn Jocqué).

Abdomen (Figs 14–16). Tergite I bare; tergites II–VIII with transverse anterior band of somewhat stronger spinules; tergites III–VII with posterior patches or band of fine to somewhat stronger spinules; tergites III–VII with caudal field of fine shagreen; on tergites IV–V and VII the anterior and posterior shagreen fields appears connected by very fine shagreen, tergites III and VI with separated anterior and posterior shagreen fields; tergite IX bare. Tergite II with 50–52 hooks occupying about one third of the segment width, longest hook 10–11 μm long, shortest 3–6 μm long. Conjunctives III/IV, IV/V and V/VI with 6–8 irregular rows of spinules. Pedes spurii A well developed on segment IV, composed of 59–63 μm wide, 73–82 μm long area with 6–7 μm long spinules. Pedes spurii B weakly developed on segment II, 54 μm long, 57–64 μm wide. Anal comb with 5–6 spurs, longest 14–18 μm long, shortest 3–5 μm long.

Abdominal setation. Lateral setae on segments I–VIII as: 0, 3, 3, 3, 3, 3, 4, 5; setae on segments I–IV hair-like, on segments V–VIII taeniate; setae on segment II 83, 122 and 92 μm long; on segment III 101, 115 and 97 μm long; on segment IV 100, 119 and 94 μm long; on segment V 475, 551 and 684 μm long; on segment VI 680, 662 and 670 μm long; on segment VII 558, 709, 655 and 612 μm long; on segment VIII 651, 565, 656, 490 and 673 μm long. All tergites with 1 pair of O setae.

Anal lobe. With complete fringe of 58–62 taeniae on each side, longest about 650 μm long, shortest about 240 μm long. Male genital sac overreaches anal lobe by 356 μm .

Larval exuviae (n = 1). Total length not measurable. Frontoclypeus 162 μm long (Fig. 17). Postmentum 227 μm long.

Coloration. Mentum and mandible brown; postoccipital margin black.

Head. AR 1.21. Antenna as in Figure 18; antennal segment lengths (in μm): 59, 19, 10, 12, 7. Basal antennal segment 18 μm wide, ring organ about 14 μm from base, blade 52 μm long. Pecten epipharyngis composed of three scales, each with 6–7 teeth (Fig. 19). Premandible 73 μm long, with well developed brush (Fig. 20). Mandible 150 μm long, seta subdentalis 18 μm long, pecten mandibularis as in Figure 21. Mentum (Fig. 22) 109 μm wide, 70 μm long; median teeth 10 μm wide, 9 μm long; first lateral teeth 7 μm wide, 7 μm long; second lateral teeth 10 μm wide, 11 μm long; ventromental plate 150 μm wide, 43 μm long, with 40 striae; distance between plates 36 μm .

Setae submenti situated below inner posterior corner of ventromental plates, between 4th and 5th lateral teeth. Anterior parapod with 11 simple claws, shortest 16 µm long, longest 27 µm long.

Abdomen. Procercus well developed, with 8 anal setae, longest 443 µm long. Supraanal setae not observed. Posterior parapods and anal tubules not measurable.

Remarks. Sæther *et al.* (2010) states that the few female imagines of *Polypedilum* subgenus *Polypedilum* sufficiently described have nearly straight spermathecal ducts. In *Polypedilum (P.) panacu* **sp. n.**, however, the spermathecal duct is strongly bent.

Distribution and biology. *Polypedilum panacu* **n. sp.** is known only from the type locality in Parque Nacional Cusuco, Honduras, where the larvae were collected in the leaf axils of the bromeliad *Tillandsia guatemalensis*. This bromeliad species is living epiphytic on various trees (Fig. 23) and is distributed from Mexico south to Panama (Morales & Alfaro 2003).

Other chironomid larvae belonging to the orthoclad genera *Limnophyes* Eaton, 1875, *Metriocnemus* van der Wulp, 1874 and to the subfamily Tanypodinae were collected together with the larva of the new species.

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References

- Benzing, D.H. (1980) *The Biology of the Bromeliads*. Mad River Press, Eureka, California, 305 pp.
- Donato, M. & Paggi, A. (2008) *Polypedilum parthenogeneticum* (Diptera: Chironomidae): a new parthenogenetic species from *Eryngium* L., (Apiaceae) phytotelmata. *Aquatic Insects*, 30, 51–60.
- Frank, J.H. (1983) Bromeliad phytotelmata and their biota, especially mosquitoes. *In*: Frank, J.H. & Lounibos, L.P. (Eds), *Phytotelmata: Terrestrial plants as hosts for aquatic insect communities*. Plexus, Medford, New Jersey, pp. 101–128.
- Frank J.H. & Lounibos, L.P. (2009) Insects and allies associated with bromeliads: a review. *Terrestrial Arthropod Reviews*, 1, 125–153.
- Givnish, T.J., Millam, K.C., Evans, T.M., Hall, J.C., Pires, J.C., Berry, P.E. & Sytsma, K.J. (2004) Ancient vicariance or recent long-distance dispersal? Inferences about phylogeny and South American-African disjunctions in Rapateaceae and Bromeliaceae based on ndhF sequence data. *International Journal of Plant Sciences*, 165 (4 Supplement), S35–S54.
- Hijmans, R.J., Cameron, S.E., Parra, J.L., Jones, P.G. & Jarvis, A. (2005) Very high resolution interpolated climate surfaces for global land areas. *International Journal of Climatology*, 25, 1965–1978.
- Mendes, H.F. (2002) Rearing Tanypodinae, Telmatogetoninae and Orthoclaudiinae in Brazil - an empirical approach. *Chironomus Newsletter*, 15, 29–32.
- Morales, J.F. & Alfaro, E. (2003) *Tillandsia guatemalensis*, un registro nuevo en la flora de Costa Rica. *Lankesteriana*, 8, 5–6.
- Oyewo, E.A. & Sæther, O.A. (2008) Revision of *Polypedilum (Pentapedilum)* Kieffer and *Ainuyusurika* Sasa *et* Shirasaki (Diptera: Chironomidae). *Zootaxa*, 1953, 1–145.
- Picado, C. (1913) Les broméliacées épiphytes considérées comme milieu biologique. *Bulletin Scientifique de la France et de la Belgique*, 47, 215–360.
- Roback, S.S. & Coffman, W.P. (1983) Results of the Catherwood Bolivian-Peruvian Altiplano Expedition Part II. Aquatic Diptera including Montane Diamesinae and Orthoclaudiinae from Venezuela. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 135, 9–79.
- Sæther, O.A. (1969) Some Nearctic Podonominae, Diamesinae and Orthoclaudiinae (Diptera: Chironomidae). *Bulletin of the Fisheries Research Board of Canada*, 107, 1–154.
- Sæther, O.A. (1980) Glossary of Chironomid morphology terminology (Diptera: Chironomidae). *Entomologica Scandinavica*, Supplement, 14, 1–51.
- Sæther, O.A., Andersen, T., Pinho, L.C. & Mendes, H.F. (2010) The problems with *Polypedilum* Kieffer (Diptera: Chironomidae), with the description of *Probolum* subgen. n. *Zootaxa*, 2497, 1–36.
- Spies, M. & Reiss, F. (1996) Catalog and bibliography of Neotropical and Mexican Chironomidae (Insecta, Diptera). *Spixiana*, Supplement, 22, 61–119.
- Spies, M., Andersen, T., Epler, J.H. & Watson, C.N. Jr. (2009) Chironomidae (Non-biting midges). *In*: Brown, B.V., Borkent, A., Cumming, J.M., Wood, D.M., Woodley, N.E. & Zumbado, M.A. (Eds), *Manual of Central American Diptera*. NRC Research Press, Ottawa, Ontario, Canada, pp. 437–480.
- Sublette, J.E. & Sasa, M. (1994) Chironomidae collected in Onchocerciasis endemic areas of Guatemala (Insecta, Diptera). *Spixiana*, Supplement, 20, 1–60.
- Wilson, L.D. & McCranie, J.R. (2003) The herpetofauna of the cloud forests of Honduras. *Amphibian and Reptile Conservation*, 3, 34–48.