

Taxonomy of *Simulium (Inaequalium) petropoliense* Coscarón (Diptera: Simuliidae) from Brazil, with the first description of the male and larva

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Abstract

We describe the male and larva of *Simulium petropoliense* for the first time and redescribe the female and pupa. All morphological characters are fully illustrated and comparisons with closely related species are given.

Key words: black fly, Neotropical region, taxonomy, *Inaequalium*, *S. petropoliense*, Brazil, Simuliidae

Introduction

Species of the subgenus *Inaequalium* Coscarón & Wygodzinsky are widely distributed in the Neotropical Region, extending from Central America (Panama) to northeast Argentina (Coscarón 1987, 1991; Juñent & Coscarón 2001). This subgenus includes 20 species, with the vast majority of taxa commonly found in the coastal, mountainous areas of southern Brazil (Crosskey & Howard 2004, Coscarón 1991, Coscarón-Arias & Coscarón 1997, Pessoa *et al.* 2005, Pepinelli *et al.* 2006). *Inaequalium* was erected by Coscarón & Wygodzinsky (1984) to accommodate 10 species. The adults of most of the species in *Inaequalium* are morphologically homogenous, and species recognition relies mainly on the configuration of the pupal gill filaments. The subgenus is divided into the *botulibranchium* and *inaequale* species groups, with 4 and 13 species, respectively (Crosskey & Howard 2004). The former authors did not assign *S. pseudoexiguum* Nunes de Mello & Barbosa de Almeida to any species group. More recently, two species of

Inaequalium described from Brazil were not included in any species group in the original description, because they shared characters of species in the *inaequale* and *botulibranchium* species group. These species are *Simulium maranguapense* Pessoa, Ríos-Velásquez & Py-Daniel [described as *Inaequalium maranguapense* by Pessoa *et al.* (2005) from Ceará State], and *S. margaritatum* Pepinelli, Hamada & Luz collected in the state of Bahia (Pepinelli *et al.* 2006). The taxonomic position of *Inaequalium* is controversial because several authors, for example Py-Daniel & Moreira Sampaio (1994a,b, 1995) and Strieder & Py-Daniel (2000, 2002), considered it a genus, while Crosskey & Howard (2004) regarded it as a subgenus within *Simulium* Latreille.

Coscarón (1980) described *Simulium petropoliense* based on a single reared female and pupal exuviae collected in the state of Rio de Janeiro, Brazil. Recent collecting in Brazil revealed the male and the larva of *S. petropoliense* Coscarón that are described in this paper for the first time. We also provide a redescription of the female and pupa, illustrate the morphological variation found in the pupal gill filaments, and discuss its taxonomic affinities with other simuliids species in the Neotropical Region.

Material and methods

The techniques for collection, rearing, dissection, measurements of specimens, and terminology used are those detailed by Shelley *et al.* (1997). The terminology used in the description of the larval hypostoma and mandibular teeth follows that of Adler *et al.* (2004). All images illustrating the morphology were obtained directly from specimens, using a Synoptics imaging system at The Natural History Museum, London (BMNH), as detailed by Hernández & Shelley (2005) and Hernández *et al.* (2005). We followed the classification of Crosskey & Howard (2004) for the placement of *S. petropoliense* within the subgenus *Inaequalium*. Specimens examined in this paper are deposited in the Instituto Oswaldo Cruz, Rio de Janeiro (IOC); the Entomology Department of the Natural History Museum (BMNH), London, United Kingdom; Museo La Plata, Argentina (MLP); American Museum of Natural History, New York, USA (AMNH); and Museum für Naturkunde der Humboldt-Universität, Berlin, Germany (NMHU).

Simulium (Inaequalium) petropoliense Coscarón (Figs. 1–43)

Simulium petropoliense Coscarón, 1980: 298–301. HOLOTYPE ♀ (reared), BRAZIL: Rio de Janeiro State, Petrópolis; 12.v.1979 (Coscarón) (MLP). [Examined.]

Inaequalium petropoliense [New combination of Py-Daniel (1994a,b), Py-Daniel & Moreira Sampaio (1995) on upgrading the subgenus *Inaequalium* to genus.]

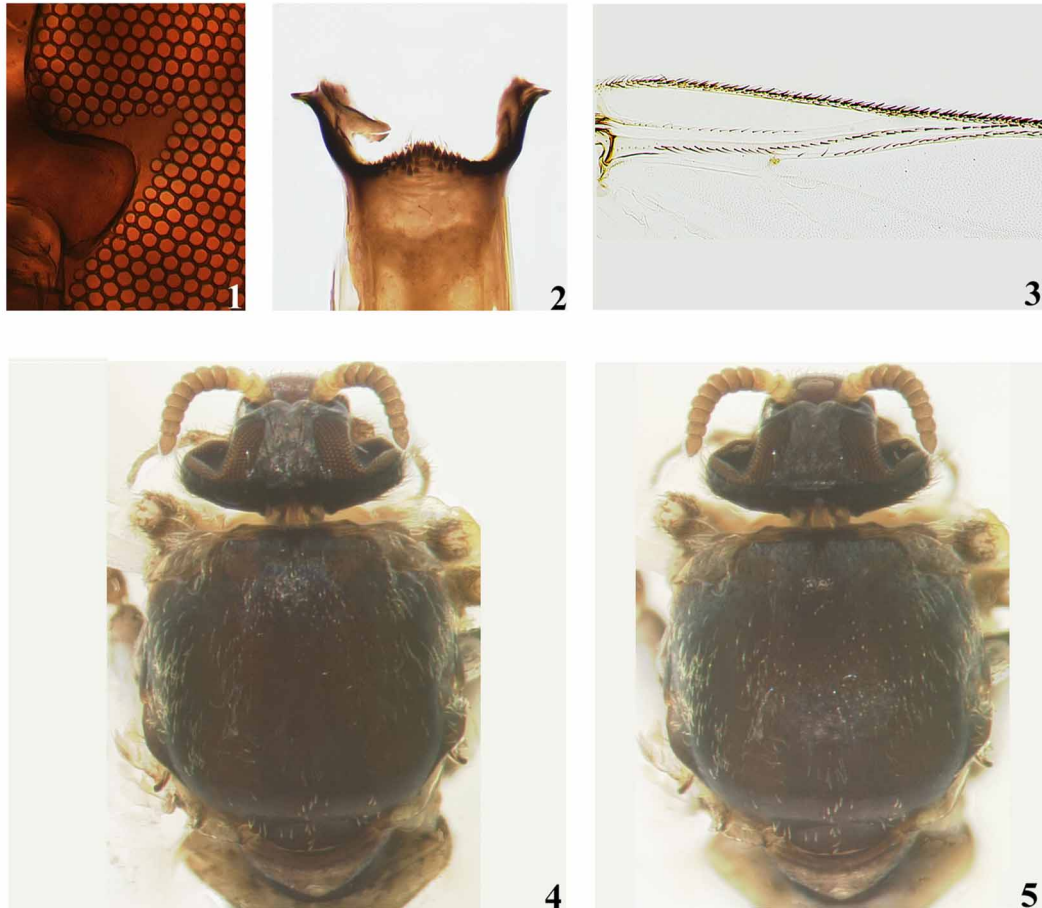
Female. Coscarón (1980) stated in the original description of *S. petropoliense* that the females are similar to females of *S. botulibranchium*. We redescribe the female of *S. petropoliense* based on two pharate females and an examination of a slide containing one hind leg, one wing, and the genitalia of the holotype. General body colour black. Body length (specimens in ethanol) 2.8–3.5 mm ($n = 2$).

Head—dichoptic with dark red eyes and nudiocular area slightly developed (Fig. 1). Frons, clypeus, and occiput black, with silvery grey pruinosity; frons, clypeus, and occiput with semi-recumbent, black hairs interspersed with white erect hairs. Mouthparts black. Antennae with scape and pedicel yellowish brown, rest of flagellar segments dark brown. Cibarium with well developed, sclerotized cornuae and group of sharp teeth of varying size extending from base of cornuae to central area of cibarium, which is weakly protuberant (Fig. 2).

Thorax—scutum black, covered with recumbent, pale golden hairs [specimen photographed in ethanol]. Scutal pattern variable depending on light incidence. With anterior illumination scutum black; humeri yellowish, lateral and posterior margins black (Fig. 4). With posterior illumination, thorax black, with faint 1+1 median, grey pruinose vittae on anterior region of scutum (Fig. 5) [this pattern not clear on photograph, as specimen was photographed in ethanol]; humeri yellowish; lateral and posterior margins weakly pruinose. Scutellum pale brown, devoid of hairs in single specimen examined. Postnotum dark brown with grey pruinosity. Pleura black with silver pruinosity. Wing venation as in Fig. 3. Costa of wing with sparse distribution of spines and setae. Subcosta with line of setae, except apical one third bare. Radius with row of setae intermixed with distinct spines, basal section of radius with line of setae. Basal tuft of sparse, light brown setae. Leg coloration as in Figs. 6–8 [based on teneral specimen]. Foreleg with coxa pale brown, trochanter, femur, inner margin and apex of tibia, and basitarsal segments I–IV dark brown to black; basal two thirds of outer margin of tibia whitish. Mid leg with coxa, trochanter, apex of femur and tibia, and apex of basitarsal segments I–II dark brown; basal two thirds of femur pale brown; basal two thirds of tibia and basitarsal segment I, and base of basitarsal segment II whitish. Hind leg with coxa, trochanter, apical third of femur and tibia, and apex of basitarsal segments I–II dark brown; basal two thirds of femur pale brown; basal two thirds of tibia and basitarsal segment I, and base of basitarsal segment II whitish. Claws weakly curved, with small basal tooth (Fig. 9). Halteres lemon yellow with dark brown base.

Abdomen—tergite I pale brown, tergite II dark brown with silver pruinosity on anterior margins; tergites II–IX black. Tergal plates weakly developed. Sternites greyish; genitalia black. Eighth sternite weakly sclerotized with long, irregularly distributed setae on posterior margin; gonapophyses sub-triangular, half length of eighth sternite at midpoint, membranous, except sclerotized internal margins (Fig. 10). Cercus sub-oval, sclerotized, covered with distinct, long, brown setae; paraproct sub-triangular, sclerotized, extended ventrally 1.5 times longer than height of cercus with distinct prominence on posterior

margin at junction with cercus; paraproct covered with long setae on posterior half and macrotrichia apically (Fig.11). Genital fork sclerotized, with stem slightly expanded apically; termination of lateral arms with anterior and posterior process developed, sub-triangular (Fig. 12). Spermatheca sub-oval, without external sculpturing and irregularly distributed spicules on internal surface; area of insertion of spermathecal duct membranous.



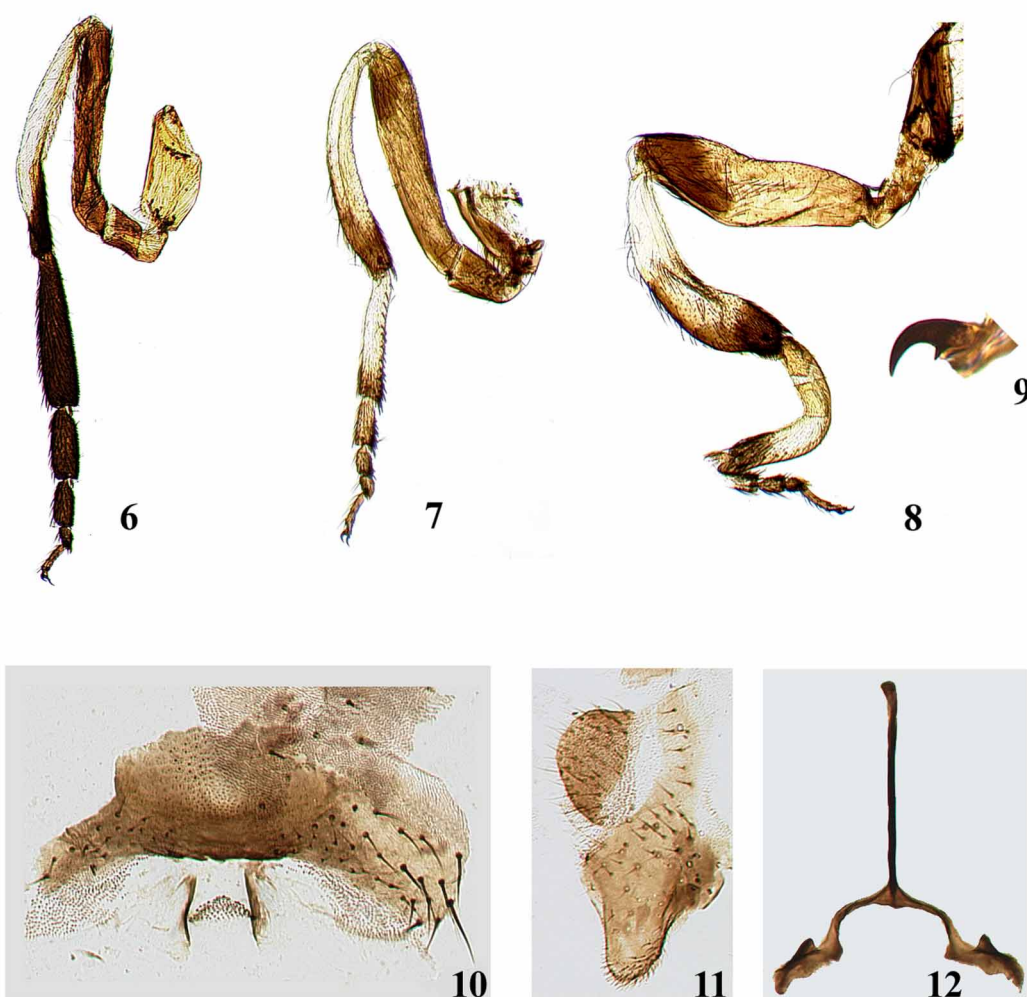
FIGURES 1–5. *Simulium petropoliense* (Diptera: Simuliidae) female. **1.** Nudiocular area. **2.** Cibarium. **3.** Anterior region of wing (Holotype). **4.** Scutal pattern (light source anterior). **5.** Scutal pattern (light source posterior).

Male. General body colour black. Body length (specimen in ethanol) 2.6–3.2 mm ($n = 2$). Wing length 1.98 mm ($n = 1$); wing width 0.8 mm ($n = 1$).

Head – holoptic with dark red eyes. Frons and clypeus with silvery grey pruinosity and covered by dark hairs. Mouthparts black. Antennae with scape and pedicel yellowish brown, rest of flagellar segments black (Figs. 13–15).

Thorax – scutum dark black covered with evenly distributed golden, recumbent hairs

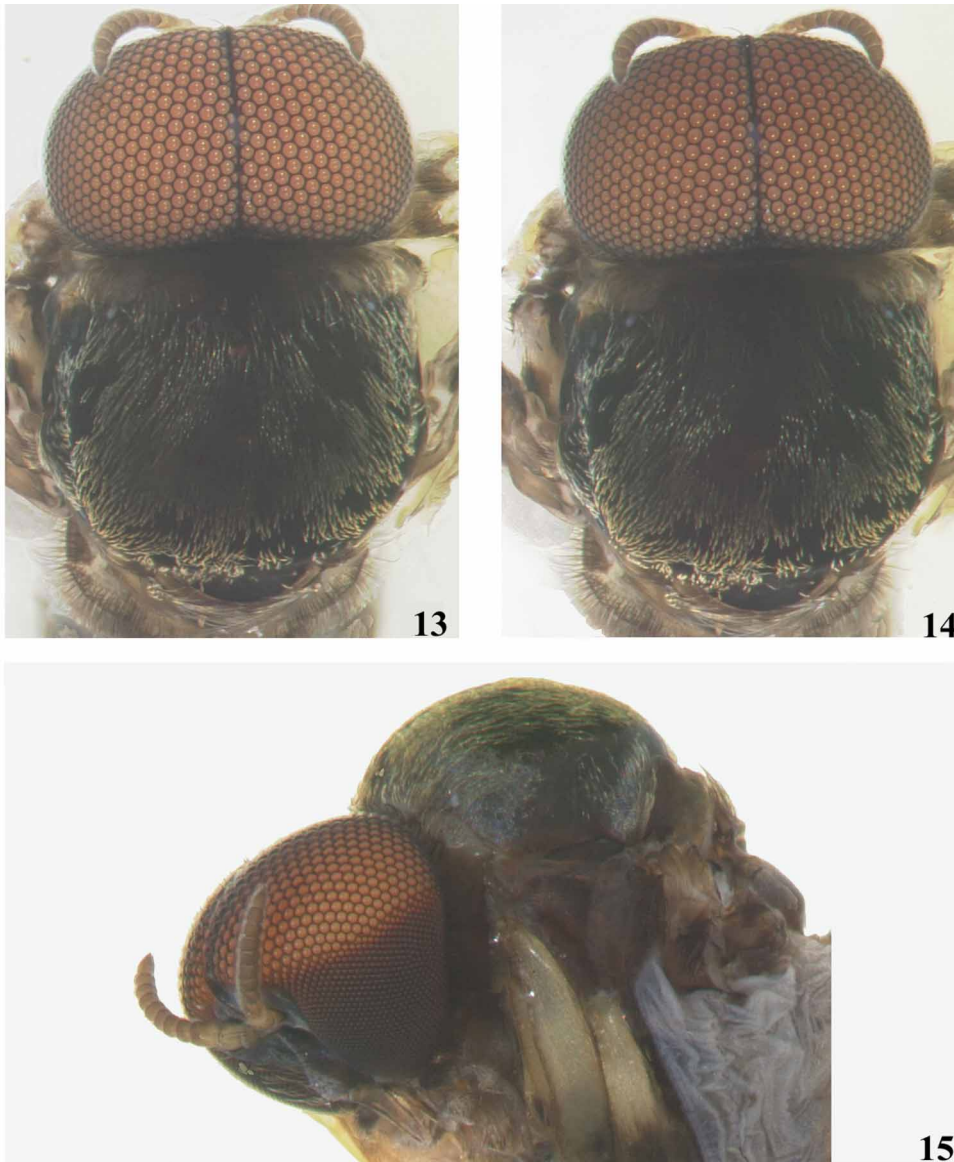
[specimen photographed in ethanol]. Thorax, regardless of light incidence, black (Figs. 13, 14), but with faint 1+1 silver cunae if specimen tilted dorso-laterally (Fig. 15); humeri pale yellow; lateral and posterior margins black. Scutellum pale brown covered with recumbent, golden hairs interspersed with long, erect, dark brown setae. Postnotum dark brown with silvery grey pruinosity. Pleura black with grey pruinosity. Halteres whitish yellow with light brown base. Wing setation as in female except Sc bare. Leg coloration as in female (Figs. 16–18). Claws without tooth but with thumb-like protuberance (Fig. 19). Femur and tibia of hind leg with lanceolate setae.



FIGURES 6–12. *Simulium petropoliense* (Diptera: Simuliidae) female. **6.** Front leg. **7.** Mid leg. **8.** Hind leg. **9.** Claw of hind leg. **10.** Eighth sternite and gonapophyses (Holotype). **11.** Cercus and paraproct (Holotype). **12.** Genital fork.

Abdomen—tergites dark brown to black, basal fringe with long, brown hairs. Faint silver pruinose ornamentation on ventro-lateral margins of tergites II, III–VIII. Genitalia black; sternites greyish with faint silver pruinosity [specimen in ethanol]; tergal plates

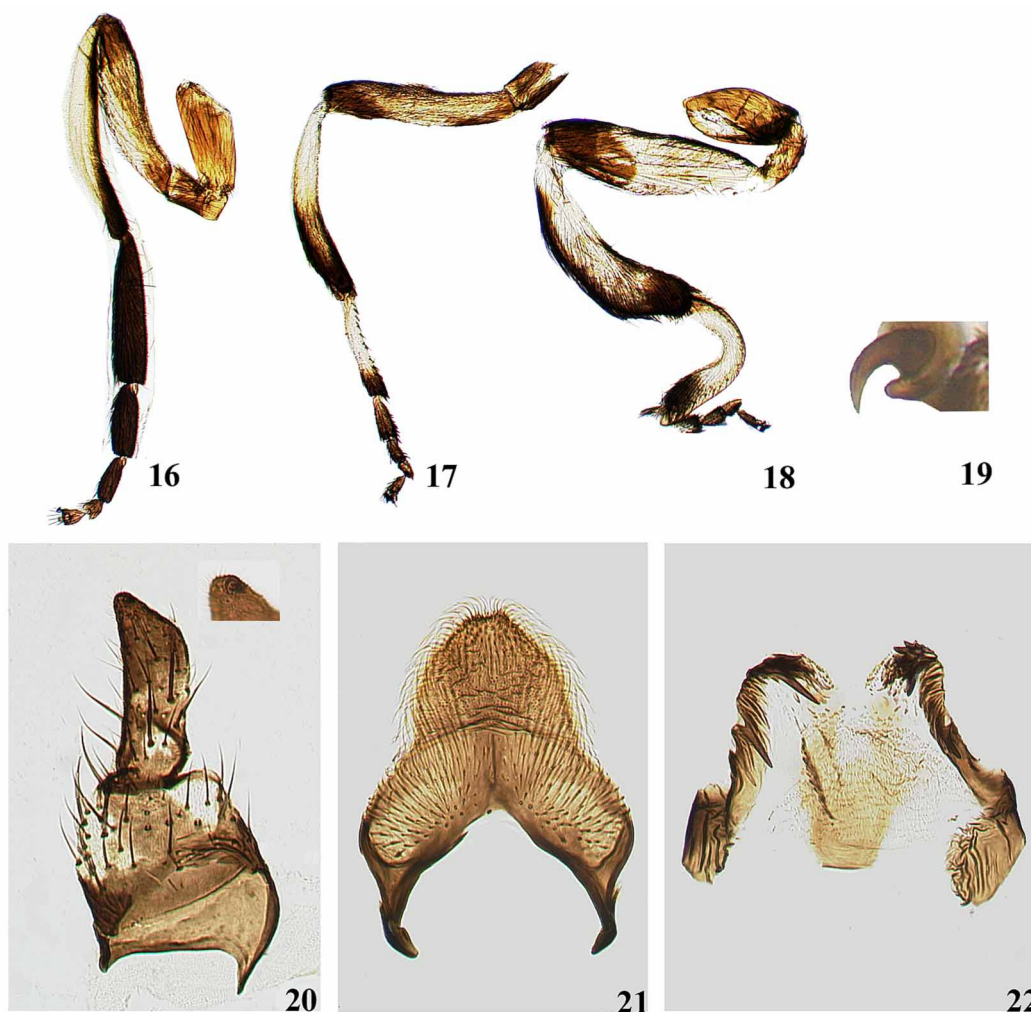
undeveloped. Gonoxocite sub-quadrangular; gonostyle sub-trapezoidal, nearly same length as gonocoxite, terminating in single spine; gonocoxite and gonostyle covered with long setae (Fig. 20). Ventral plate sclerotized, with main body well developed, prominently produced on anterior margin, and with wide concavity on central region of posterior margin; basal arms sclerotized and curved inwards; main body of ventral plate covered by long hairs (Fig. 21). Median sclerite pyriform, as long as wide at mid point, with incision on apical one third (Fig. 22). Paramere with developed and sclerotized basal process and numerous long and short spines along distal half; membrane between basal arms of paramere with fine spicules (Fig. 22).



FIGURES 13–15. *Simulium petropoliense* (Diptera: Simuliidae) male. **13.** Scutal pattern (light source anterior). **14.** Scutal pattern (light source posterior). **15.** Head and thorax (lateral view).

Pupa. Cocoon length dorsally 2.3–2.8 mm (mean = 2.5 mm, s.d. = 0.14, $n = 9$); ventrally 2.6–3.2 mm (mean = 3.2 mm, s.d. = 0.21, $n = 7$); pupa length 2.0–2.6 mm (mean = 2.3 mm, s.d. = 0.20, $n = 7$); gill length 1.1–1.9 mm (mean = 1.4 mm, s.d. = 0.2, $n = 9$).

Cocoon—slipper-shaped (as in Figs. 23, 24), light to dark brown, composed of fine network of coalescent fibres and reinforced rim to anterior aperture.



FIGURES 16–22. *Simulium petropoliense* (Diptera: Simuliidae) male. **16.** Front leg. **17.** Mid leg. **18.** Hind leg. **19.** Claw of hind leg. **20.** Gonocoxite and gonostyle, inset detail of gonostyle. **21.** Ventral plate (ventral view). **22.** Paramere and median sclerite.

Gill—light to dark brown with 5 (sometimes 6) forwardly directed filaments arranged in vertical plane. Gill variable, common pattern as follows: gill configuration with main trunk short giving rise to 2 strongly asymmetrical primary branches, 1 dorsal and 1 ventral. Dorsal primary branch conspicuously thick and divided into 4, finger-like filaments apically. Ventral primary branch single and distinctly curved at mid point (Fig. 25). All

filaments rounded distally, distinctly covered with short black setae, edges weakly crenate. Variation in gill configuration occurs sometimes, with dorsal branch dividing apically into secondary branches at different heights and ventral primary branch having 1 or 2 filaments distally (Figs. 27–28). Another variation occurs in which primary branch divides on basal one third into 2 elongate secondary branches; both then bifurcate more apically into tertiary filaments, all branches covered by long hairs (Fig. 29).

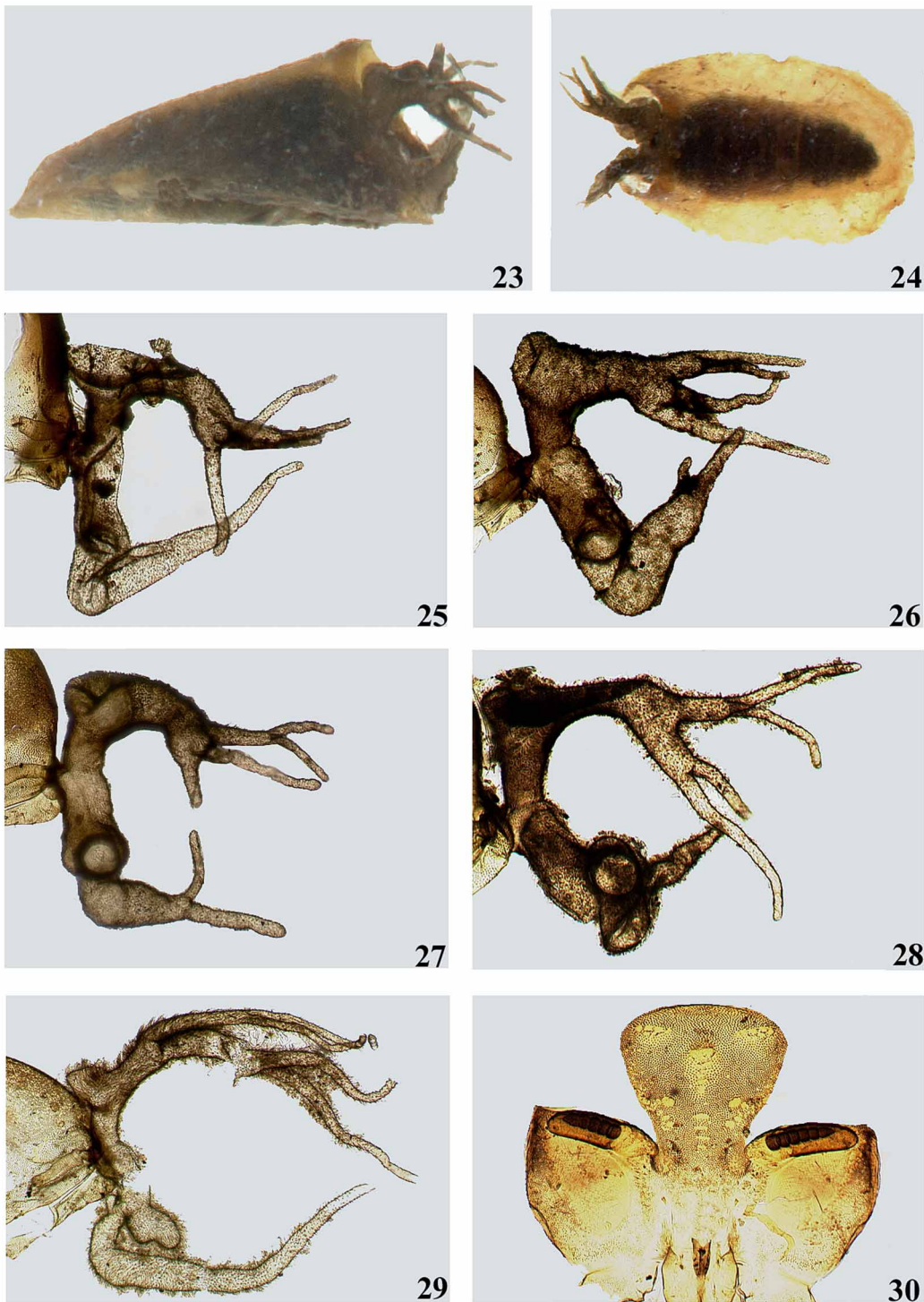
Head—frontoclypeus with 2+2 long, single, bifid, or trifid frontal and 1+1 long, bifid or quadrifid, facial trichomes; frontoclypeus with group of platelets mesally, 1+1 groups of approximately 13 platelets dorso-laterally and 2 groups of platelets in groups of 2–3 laterally in frontal region; tubercles rounded and densely distributed over entire surface (Fig. 30).

Thorax—with approximately 4+4 long, bifid to quadrifid trichomes near margin of dorsal cleft, 1 long, bifid trichome on posterior region mesally, 1+1 long and 1+1 small, simple trichomes on alar region, and 3+3 long, simple trichomes on ventral margin of alar region; tubercles rounded (some pointed near base of gill) and densely distributed over entire surface of thorax.

Abdomen—tergite I with 1+1 long, sub-lateral, simple trichomes; tergite II with 3+3 sub-median, spiniform setae in row, 3+3 small, simple trichomes in vertical line to spiniform outer setae, and 1+1 spiniform setae on lateral margin; tergites III–IV with 4+4 sub-median, simple hooks in row along posterior margin, 1+1 simple trichomes anterior to outer trichomes, and 1+1 spiniform setae on lateral margin; tergites V–VI without trichomes or setae; tergites VII and VIII without visible trichomes, but well-developed spine combs resembling teeth on anterior margin; tergite IX weakly sclerotized, with well-developed spine combs resembling teeth on anterior margin and terminating in 1+1 small, apical spines. Abdominal sternite III with 3+3 sub-median and 2+2 lateral spiniform setae; sternite IV with 1 sub-median and 2+2 lateral spiniform setae; sternite V with 2+2 separated bifid or trifid hooks on posterior margin, and 2+2 sub-lateral and 2 lateral spiniform setae; sternite VI with 2+2 separated bifid hooks on posterior margin, 1+1 spiniform setae anterior to outermost hooks, 1+1 long, trichomes between outermost hooks; sternite VII with 2+2 well separated bifid or simple hooks on posterior margin, 1+1 long, simple trichomes between and anterior to outermost hooks; sternite VIII without setae; sternite IX sclerotized. Spine combs on anterior margin of sternites III–IX.

Mature larva. Body length 4.7–5.8 mm (mean = 5.4 mm, s.d. = 0.32, $n = 9$); width of head capsule 0.5–0.8 mm (mean = 0.5 mm, s.d. = 0.09, $n = 9$); length of head capsule 0.4–0.7 mm (mean = 0.6 mm, s.d. = 0.09, $n = 10$). Body colour dark grey dorso-laterally, whitish ventrally (specimens preserved in ethanol). Form as in Fig. 31.

Head—mainly pale and dark brown, anterior region of cephalic apotome yellow. Numerous small setae present on all surfaces and head capsule slightly wrinkled. Head pattern positive (Fig. 32). Postgenal cleft narrow, bell-shaped with sub-triangular



FIGURES 23–30. *Simulium petropoliense* (Diptera: Simuliidae) pupa. **23.** Cocoon (lateral view). **24.** Cocoon (dorsal view). **25.** Gill configuration (typical form). **26–29.** Gill variations. **30.** Frontoclypeus.

extension at apex; postgenal bridge as long as hypostoma (Figs. 33–34). Hypostoma strongly pigmented on anterior margin with 9 apical teeth; simple median tooth sharp, well developed and more prominent than 3+3 sub-lateral teeth, but of similar dimensions to 1+1 lateral teeth; 2+2 small para-lateral teeth and 4–5 lateral serrations [tiny intermediate teeth seen only at high magnification on either side of median and sub-lateral teeth]; hypostoma with 1+1 lines of 4–5 hypostomal setae parallel to lateral margin and 1+1 long setae in posterior half of hypostoma (Fig. 35). Antennae nearly as long as labral fan, pigmented; segment proportions (proximal, $n = 5$; median, $n = 5$ and distal, $n = 6$) approximately 0.02–0.07:0.05–0.08:0.06–0.1, antennal segments I–II pale brown, segment III brown (Fig. 36). Mandible with second comb tooth longer than first and third, 10 internal teeth, and 2 mandibular serrations, with anterior longer than posterior; mandibular combs well developed (Fig. 37). Mandibular lateral process single (Fig. 38). Maxillary palps heavily pigmented; three times as long as wide at base. Cephalic fan with approximately 30–50 rays ($n = 6$).

Thorax—grey dorsally and ventrally. Cuticle apparently without setae. Proleg with plate heavily sclerotized with approximately 28–32 processes of nearly 10–13 hooks ($n = 3$). Pupal respiratory gill histoblast dark brown; dissected gill histoblast with 5 filaments.

Abdomen—usually grey dorsally, progressively paler ventrally, especially toward posterior where last segments white [in some specimens, some abdominal segments are yellowish dorsally]. Ventral nerve cord whitish. Ventral papillae present, small. Cuticle mainly lacking setae, except area around anal sclerite. Anal sclerite well sclerotized, with posterior arms extending one third of circumference of posterior circlet; no sclerotized areas between arms (Fig. 39). Posterior circlet with approximately 40–80 rows of 14–20 hooks ($n = 6$). Anal gill not everted in specimens examined.

Taxonomic discussion

Simulium petropoliense was described by Coscarón (1980) from a reared female holotype and pupal paratype collected in Petrópolis, Rio de Janeiro State, on 12.v.1979 by this author. On a visit to MLP, the first author of the current paper examined the type material of *S. petropoliense*. The material identified as *S. petropoliense* housed in MLP consists of a pinned reared female and two slides. One slide contains the genitalia of a female (only the genital fork, spermatheca, gonapophyses, cercus, and paraproct), one wing and one hind leg. This slide does not bear a label stating locality, date or collector's name, but it has a white label in Coscarón's hand "*Simulium petropoliense* ♀ n. sp." and "parte del Holotipo" [= part of the Holotype]. The stem and the left lateral arm of the genital fork are broken. The coxa of the hind leg is missing. The other slide, which is labelled as paratype, only contains a pupal exuviae. However, the pinned reared female labelled as holotype (HOLOTIPO) of *S. petropoliense* does not belong to this species. This specimen is entire and has been glued, together with its pupal exuviae, to a card point, which is attached to the pin. The number and configuration of the pupal gill filaments

agree with the pattern found in *S. souzalopesi* Coscarón and it has been labelled accordingly (see Material Examined). This problem was discussed with Sixto Coscarón, who agreed with Luis Hernández's identification. The remains of the single reared female of *S. petropoliense*, which was partly dissected by Coscarón to illustrate the morphology of the genitalia of *S. petropoliense* (Coscarón 1980), was not found in the MLP holdings and it is now considered lost. The morphology of the gonapophyses and hind leg in the single slide, which bears on its label "part of the holotype", agree with Coscarón's illustrations of *S. petropoliense*. Consequently, we consider that this is all that remains of the holotype of *S. petropoliense* and it has been labelled accordingly (see Material Examined).

Simulium petropoliense is placed in the *botulibranchium* species group by the combination of characters given by Coscarón (1980, 1987, 1991), especially the females with a sub-triangular paraproct with a basal protuberance (Fig. 11); male with an elongate, sub-triangular gonostyle, the same length as the gonocoxite (Fig. 20), and pupa with asymmetrical gill filaments (Figs. 25–29). We agree with the placement of *S. petropoliense* in this species group. We have compared *S. petropoliense* with the three other species of the *botulibranchium* species group (*sensu* Crosskey & Howard 2004) based on images in the BMNH image archive, specimens in the AMNH, BMNH, IOC, MLP, and NMUH collections, and descriptions and figures in Coscarón (1980).

The morphology of the female genitalia separates *S. lurybayae* Smart from *S. petropoliense*, *S. botulibranchium* Lutz, and *S. souzalopesi*. In *S. lurybayae*, the paraproct is sub-quadrangular, extending ventrally nearly by the same length as the cercus, and with a small protuberance basally (BMNH image archive). This configuration agrees with the general morphology of most of the species in the *inaequale* species group. The male, pupa, and larva of *S. lurybayae* are unknown. In *S. petropoliense*, *S. botulibranchium*, and *S. souzalopesi* the paraproct is sub-triangular extending ventrally 1.5 times beyond the junction with the cercus, and has a distinct protuberance on the posterior margin basally (Fig. 11; Coscarón 1980). The female of the latter three species cannot be separated without examination of the pupal gill filaments. Based on the morphology of the male genitalia, especially the ventral plate, the male of *S. petropoliense* is most similar to the male of *S. botulibranchium* by having the basal arms of the ventral plate reduced (Fig. 21; Coscarón 1980). *Simulium souzalopesi* is quite distinct by having the ventral plate with well-developed basal arms that distinctly curve inwards (Coscarón 1980).

The most reliable character to recognise *S. petropoliense* is the configuration of the pupal gill filaments. *Simulium petropoliense* and *S. botulibranchium* differ from *S. souzalopesi* in that in the latter species the pupal gill filaments are bare and there are only 6 filaments (Coscarón 1980). In *S. petropoliense* and *S. botulibranchium*, the gills are stout and bulbous for their main part and consist of a dorsal and a ventral primary branch that divide from the main stem basally in the vertical plane, each of them forming a right angle or nearly a right angle, causing the rest of the gill to be directed anteriorly. A prominence

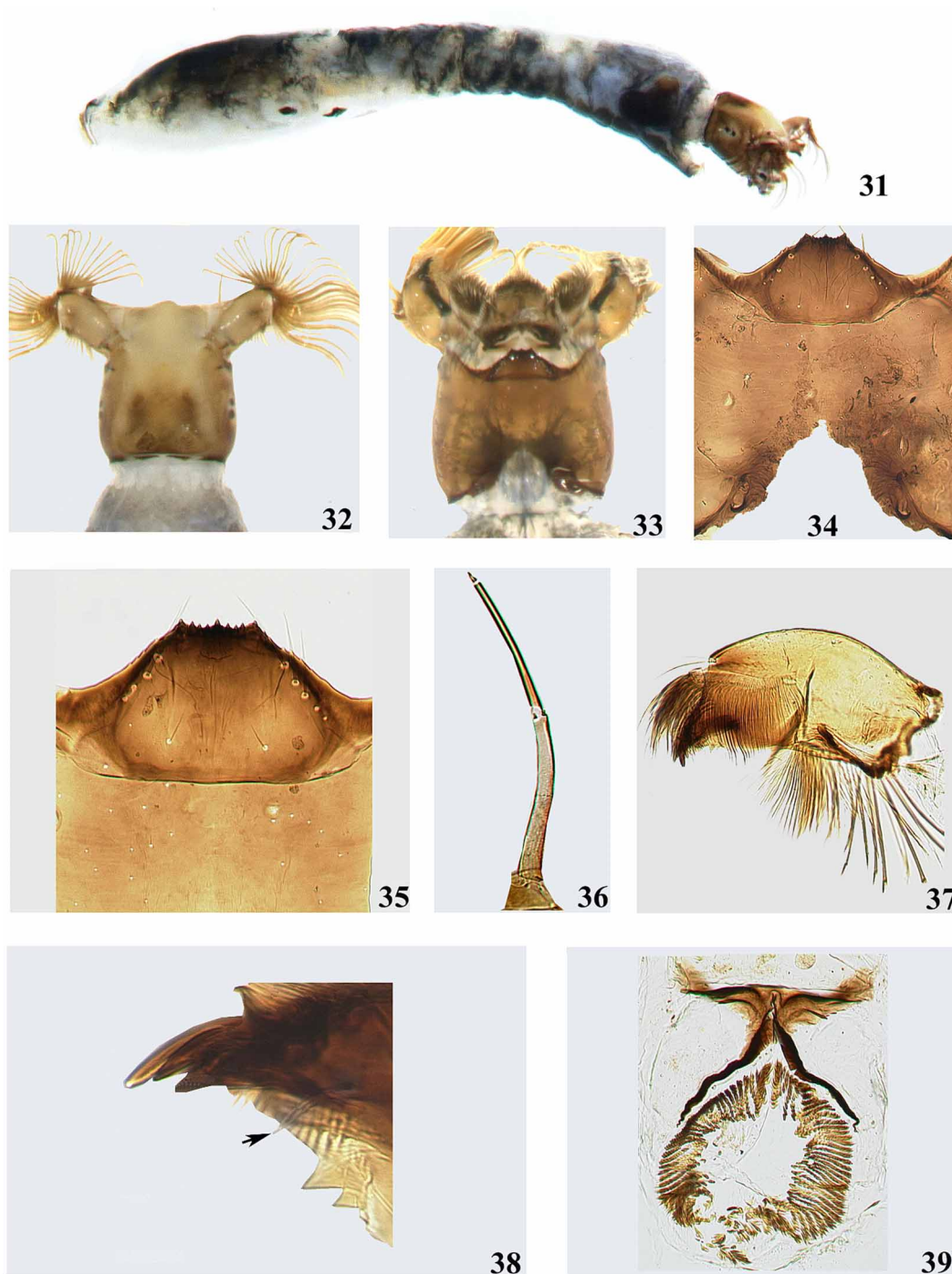
is present on each primary branch at or near the right angle bend (Figs. 23–29; Coscarón 1980). The dorsal primary branch in the two species then divides into four (*S. petropoliense*) or up to five (*S. botulibranchium*) secondary branches of variable length. In *S. petropoliense*, they are finer and longer (Figs. 25–29), but much stouter and shorter in *S. botulibranchium* (BMNH image archive; Coscarón 1980). The ventral primary branch remains bulbous and simple in *S. botulibranchium* (BMNH image archive; Coscarón 1980), but it can be single or divided into two filamentous secondary branches in *S. petropoliense* (Figs. 25–29). Another difference between these two species is the morphology of the gill surface. In *S. botulibranchium*, the gill is covered in minute spicules, whereas in *S. petropoliense* it is covered with hairs (Figs. 25–29).

The larva of *S. petropoliense* externally resembles that of *S. botulibranchium* because of its similar postgenal cleft (Figs. 33–34; Fig. 2G in Coscarón 1980), which is large and bell-shaped with a distinct median incision. However, it can be reliably identified by the different configuration of the dissected pupal gill histoblasts. The larva of *S. souzalopesi* is easily identified by the shorter postgenal cleft (Coscarón 1980, Fig. 4G) and the pupal gill histoblasts with 6 filaments, not covered by hairs or spinules.

Variation in the pupal gill filaments, frontoclypeal trichomes, and setation of abdominal sternites V–VIII was seen in specimens of *S. petropoliense* that we examined. The configuration of the filaments is of the same general pattern shown in Figs. 25–29. Branching heights, girth of filaments, and setation can vary. The more common form is that shown in Fig. 25, with the bulbous dorsal primary branch giving rise to four narrower filaments in the distal half of the gill and the single bulbous ventral branch becoming narrower distally. Less common forms include the branching of secondary filaments at the midpoint of the gill (Figs. 26, 27), in the basal half of the gill (Figs. 28, 29) and with the ventral primary branch being bifid distally (Figs. 26, 27). Setation varies from short setae (0.02–0.03mm, $n = 5$; Figs. 25–27) to longer setae in the specimens with more basal branching of the gill filaments (0.05 mm, $n = 3$; Figs. 28, 29). The range of variations above was observed in two nearby localities in the Municipality of Petrópolis, Rio de Janeiro (see also Material Examined): a stream below a waterfall on the Rio de Janeiro to Jardim de Itaipava road (BR040), in the first waterfall after Alto da Mozela (site 1695) (Figs. 40–41), and Rio de Janeiro to Jardim de Itaipava road (BR040), waterfall in front of Posto Brasília (site 1696, 1697). Coscarón (1980: 300, Fig. 5F) figured a 1+1 single facial trichome on the frontoclypeus, but specimens with bifid or trifid facial trichomes were seen in our material and the hooks on sternites V–VII can be either bifid or trifid.

Distribution

Simulium petropoliense has been collected only in Brazil in Petrópolis Municipality, Rio de Janeiro State (Crosskey & Howard 2004; Coscarón 1980, 1987, 1991; Strieder & Py-Daniel 2000; Material examined).



FIGURES 31–39. *Simulium petropoliense* larva (Diptera: Simuliidae) larva. **31.** Larval habitus (lateral view). **32.** Head (dorsal view). **33.** Head (ventral view). **34.** Hypostoma and postgenal cleft (ventral view). **35.** Hypostoma (ventral view). **36.** Antennal segments. **37.** Mandible (lateral view). **38.** Anterior part of mandibular teeth, with arrow indicating mandibular lateral process. **39.** Anal sclerite and posterior cirlet.

Biology and medical importance

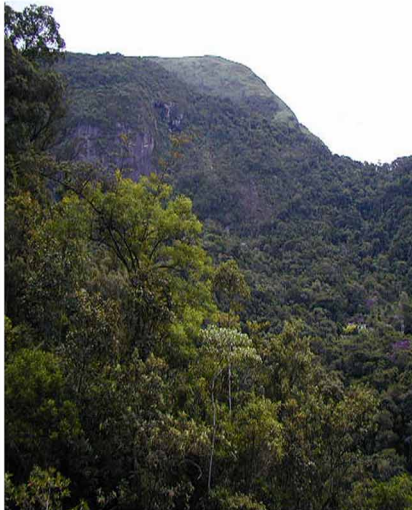
Coscarón (1980, 1991) and Strieder & Py-Daniel (1999) stated that the immature stages of *Simulium petropoliense* can be collected in open spaces in small trickles with clear water, commonly attached to vegetation and rocks, sympatric with *S. botulibranchium* and *S. souzalopesi*. We have collected larvae and several pupae of *S. petropoliense* attached to rocks in trickles of clear water in a waterfall. It was also collected on leaves where the water was running faster. The immature stages were collected in the open part of the waterfall receiving direct sunlight (Figs. 40–43). The alimentary habits of *S. petropoliense* are not known. Females have never been found biting humans in Brazil.



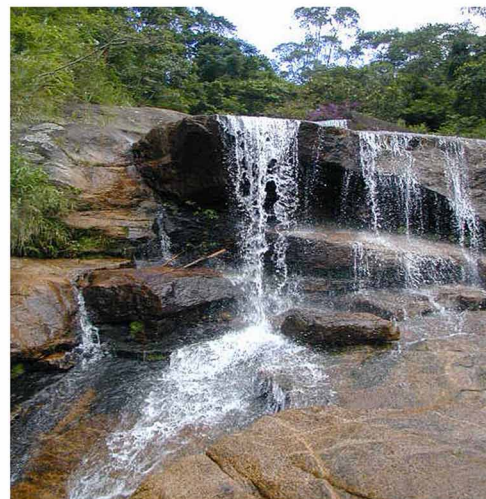
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FIGURES 40–43. Typical breeding grounds of *Simulium (Inaequalium) petropoliense* in Brazil, Rio de Janeiro State. **40, 41.** Different sections of the first waterfall after Alto da Mozela, (site 1695) on Rio de Janeiro to Jardim de Itaipava road (BR040). **42, 43.** Forest and waterfall in front of Posto Brasília, (site 1697) on Rio de Janeiro to Jardim de Itaipava road (BR040).

Material examined***Simulium (Inaequalium) petropoliense* Coscarón**

Type material

Brazil

Rio de Janeiro State

Slide

[Without locality information, date, or collector's name.]—1 ♀ (slide) (only one hind leg, one wing, and genitalia; adult lost) [HOLOTYPE] (MLP). [The specimen is not labelled with locality data, but agrees with the information given in the original description of *S. petropoliense* (Coscarón, 1980)]. [The specimen bears a white label in Coscarón's hand "*Simulium petropoliense* ♀ n.sp. parte del Holotipo". We have added other labels: White label in Luis Hernandez's hand "This is what remains of the holotype of *S. petropoliense*. The pinned ♀ and pupa is now lost. L.M.Hernández 2005"; White label "Digitally photographed wing, leg, and genitalia (all) L.M.Hernández 2005"]. Petrópolis; 12.v.1979, (Coscarón)—1 pupa [PARATYPE] (MLP).

OTHER MATERIAL

Brazil

Rio de Janeiro State

Slide

Estrada de Rio de Janeiro ao Jardim de Itaipava, BR040, cachoeira in front of Posto Brasília, (site 1697a–b); 23.iii.2005, (L.M.Hernández & A.P.A.Luna Dias)—1 pharate ♂, 2 pharate ♀, 4 pupae, 6 larvae (BMNH). Estrada de Rio de Janeiro ao Jardim de Itaipava, BR040, first cachoeira after Alto da Mozela, (site 1695); 22.iii.2005, (L.M.Hernández & A.P.A.Luna Dias)—1 pharate ♂, 1 pupa (IOC).

Spirit

Estrada de Rio de Janeiro ao Jardim de Itaipava, BR040, cachoeira in front of Posto Brasília, (site 1697a–b); 23.iii.2005, (L.M.Hernández & A.P.A.Luna Dias) —several pupae and larvae (BMNH; IOC).

Other species examined***Simulium (Inaequalium) botulibranchium* Lutz**

TYPE MATERIAL

Brazil

Rio de Janeiro State

Slide

[Without locality, date, or collector's name.]—1 pupal exuviae [LECTOTYPE] (IOC, no. 12.038) [The slide has several labels: 1—White, handwritten label “*Simulium botulibranchium* Lutz”; 2—White “12.038, Bd 103”. It also has a white label “312”. We have added other labels: A white, handwritten label by L.M.Hernández “Lectotype designated by d’Andretta & d’Andretta 1947:161” and “Photographed Parts of gill, cocoon weave, frontoclypeus trichomes L.M.Hernández 2003”.] [The locality information “Rio de Janeiro State, Morro do Observatorio, Petrópolis, collector A. Lutz, 1910” has been given by D’Andretta & D’Andretta (1947).]

OTHER MATERIAL

Brazil

Rio de Janeiro State

Pinned

Petrópolis, stream from mountain at km 85 towards Rio, (site 1687, D25), 22°31’S 44°14’W; 18.iii.2004, (A.J.Shelley, A.P.A.Luna Dias & P.R.Garritano)—2♀, 2♂ (BMNH; IOC). Petrópolis; 11.ix.1911, [Without collector’ name.]—2♀ (on same pin), 1♂ (IOC, no. 12.476) [The specimens bear a purple label “Tipo”. We have added a white label “*Simulium botulibranchium* Lutz ? Det. L.M.Hernández”]. Estrada de Rio de Janeiro ao Jardim de Itaipava, BR040, BR040, first cachoeira after Alto da Mozela, (site 1695); 22.iii.2005, (L.M.Hernández & A.P.A.Luna Dias)—1♂ (reared) (IOC). Estrada de Rio de Janeiro ao Jardim de Itaipava, BR040, cachoeira in front of Posto Brasão, (site 1696a–b); 22.iii.2005, (L.M.Hernández & A.P.A.Luna Dias)—1♂ (reared) (IOC). Estrada de Rio de Janeiro ao Jardim de Itaipava, BR040, cachoeira in front of Posto Brasão, (site 1697, 5A1–2); 23.ii.2005, (L.M.Hernández & A.P.A.Luna Dias)—1♀, 1♂ (reared) (IOC). Petrópolis, stream from mountain at Km 85 towards Rio, (site 1687); 20.iii.2004, (A.J.Shelley, A.P.A.Luna Dias & P.R.Garritano) – 1♂ (reared) (IOC).

Slide

[Without locality information, date, or collector’s name.]—1♂ (only genitalia and one hind leg) (IOC, no. 12.037, Bd. 103) [The slide bears a handwritten label “*S. botulibranchium* ♂ Typo” and a printed, white label “311”. We have added other labels: a white label “Digitally photographed hind leg, gonostyle + gonocoxite. Taken by L.M.Hernández BMNH 2003” and a white label “*Simulium botulibranchium* Lutz? Det. L.M.Hernández.]. Petrópolis, stream from mountain at km 85 towards Rio, (site 1687, D25), 22°31’S, 44° 14’W; 18.iii.2004, (A.J.Shelley, A.P.A.Luna Dias & P.R.Garritano)—1♀, 1♂ (reared), 1 pupa, 2 larvae (BMNH).

Spirit

Petrópolis, stream from mountain at km 85 towards Rio, (site 1687, D25), 22°31’S, 44° 14’W; 18.iii.2004, (A.J.Shelley, A.P.A.Luna Dias & P.R.Garritano) —numerous pupae (BMNH; IOC). Estrada de Rio de Janeiro ao Jardim de Itaipava, BR040, cachoeira in front

of Posto Brasão, (site 1696ab); 22.iii.2005, (*L.M.Hernández & A.P.A.Luna Dias*)—2 pupae (BMNH). Estrada de Rio de Janeiro ao Jardim de Itaipava, BR040, cachoeira in front of Posto Brasão, (site 1697ab); 23.iii.2005, (*L.M.Hernández & A.P.A.Luna Dias*)—several pupae, larvae (BMNH; IOC).

São Paulo State

Pinned

Nth. Serra da Bocaina, (loc 22); 15–18.v.1979, (*R.W.Crosskey & A.J.Shelley*) —1 ♀ (reared, only thorax; head, wings, legs, abdomen, and genitalia on slide) (BMNH, BM 1979-258). S. José do Barreiro, Nascente na Faz. S. Sebastião da Cachoeira, (site 1675, D13); 18.iii.2004, (*A.J.Shelley, A.P.A.Luna Dias & P.R.Garritano*) —1 ♀ (IOC). Fazenda Pau d'Alho; 22.vi.1947, (*Marino & Pereira*)—1 ♂ (reared) (AMNH) [Determined by S. Coscarón 79]. Km 52 on SP183, NW. Cruzeiro, Cascade, Serra da Mantiqueira, (site 462); 18.v.1979, (*A.J.Shelley & A.P.A.Luna Dias*) —1 ♀ (reared, only thorax; head, wings, legs, abdomen, and genitalia on slide) (BMNH, B.M. 1979–580). Obiti; 23.iv.1956, [Without collector's name.]—1 ♀, 1 ♂ (reared, pupa in spirit) (BMNH; ♀ no.1330, ♂ no. 1331).

Slide

Serra da Bocaina, (loc 22); 15–18.v.1979, (*R.W.Crosskey & A.J.Shelley*)— 1 ♀ (reared, only head, wings, legs, abdomen, and genitalia; thorax pinned) (BMNH, BM 1979-258). Km 52 on SP183, NW. Cruzeiro, Cascade, Serra da Mantiqueira, (site 462); 18.v.1979, (*A.J.Shelley & A.P.A.Luna Dias*) —2 ♀ (reared, head, wings, legs, abdomen, and genitalia; thorax pinned) (BMNH, B.M. 1979-580).

Spirit

Boraceia; 30.x.1979, (*Coscarón*) —several pupae, larvae (BMNH). Obiti; 23.iv.1956, [Without collector's name.]—2 pupae (♀, ♂ pinned) (BMNH; ♀ no.1330, ♂ no. 1331). S. José do Barreiro, cachoeira going to Arapeí, (site 1673, D11); 17.iii.2004, (*A.J.Shelley, A.P.A.Luna Dias & P.R.Garritano*)—1 pupa (IOC). S. José do Barreiro, 3rd un-named stream after waterfall to Arapeí, (site 1672, D10), 20°00'S 47°48'W; 3.viii. 2004, (*A.J.Shelley, A.P.A.Luna Dias, P.R.Garritano*)—several pupae (BMNH). S. José do Barreiro, stream at 500 m from site 1676, returning to Arapeí, (site 1677, D15); 18.iii.2004, (*A.J.Shelley, A.P.A.Luna Dias & P.R.Garritano*)—1 pupa (BMNH).

Pinned

Without country or State [but probably Brazil]. [Without locality, date, or collector's name.]—1 ♀ (AMNH) [The specimen does not bear a locality label, but it bears a white printed label “156.29” which agrees with the numbering system used by M.A.V. D'Andretta (also known as M.A.Vulcano) in her studies of the Brazilian Simuliidae].

Simulium (Inaequalium) lurybayae Smart

TYPE MATERIAL

As *Simulium angustifrons* Enderlein, 1934

Bolivia

Pinned

La Paz, Luribay; iii.1913, (*Stocker, S.G.*)—1♀ (only thorax; head, wings, legs, abdomen, and genitalia on slide) [HOLOTYPE] (NMUH) [The specimen bears several labels: Green label with locality and collector information; White label handwritten by Enderlein “*Trichodagmia angustifrons* Type Ender. ♀”, printed and the bottom of the label “Dr. Enderlein det. 1933; Orange label “Typus”. We have other labels: White label “Digitally photographed parts Thorax ant.+post.; abdomen; lateral view ♀—1. L.M.Hernández BMNH 2004”; White label “Material in slide collection ♀—Holotype L.M.Hernández 2004”; White label “*Simulium lurybayae* Smart Holotype of *S. angustifrons* End., 1934. Examined by L.M.Hernández 2004”.]

Slide

Data as for the pinned adult with new labels added—1♀ (only head, wings, legs, abdomen, and genitalia; thorax pinned) [HOLOTYPE] (NMUH).

Simulium (Inaequalium) souzalopesi Coscarón

TYPE MATERIAL

Brazil

Rio de Janeiro State

Pinned

Petrópolis; 12.v.1979, (*Coscarón*)—1♀ (reared, pupa glued to a card point) [HOLOTYPE] (MLP) [The specimen bears several labels: White label in Coscarón’s handwriting with locality information, date, and collector’s name; White label “*Simulium souzalopesi* n. sp. Det. Coscarón; Red label “HOLOTIPO”. We have added another label: White label “Digitally photographed Thorax (ant.+post.), abdomen L.M.Hernández”; White label “*Simulium souzalopesi* Coscarón Determined L.M.Hernández”]. Same data as holotype—1♀, 1♂ (reared) [PARATYPES, male as ALLOTYPE; the pinned female has lost its pupal exuviae].

Slide

Same data as the holotype—1♀, 1♂ (reared, but not associated with pupa), 1 larva, 3 pupae (MLP) [PARATYPES, 2 pupae have no labels indicating their type status, but we assumed they are paratypes, as all material collected by Coscarón was designated as such (Coscarón 1980)].

Spirit

Same data as for the holotype—several pupae and larvae (MLP) [PARATYPES, the specimens do not bear labels indicating their types status, but we assumed they are paratypes as all material collected by Coscarón was designated as such (Coscarón 1980)].

Other material

Brazil

Rio de Janeiro State

Pinned

Estrada de Rio de Janeiro ao Jardim de Itaipava, BR040, cachoeira in front of Posto Brasão, (site 10), 22°27'29"S 43°12'59"W, 1017 m; 8.x.2005, (A.J.Shelley & A.P.A.Luna Dias)—1 ♀ (reared) (BMNH).

Spirit

Estrada de Rio de Janeiro ao Jardim de Itaipava, BR040, cachoeira in front of Posto Brasão, (site 1697); 23.iii.2005, (L.M.Hernández & A.P.A.Luna Dias)—1 pupa (IOC).

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