

Redescription of the female, male, and pupa of *Simulium itaunense* D'Andretta & González B. (Diptera: Simuliidae)

LUIS MIGUEL HERNÁNDEZ, ANTHONY JOHN SHELLEY, ANTONIO PAULINO
LUNA DIAS & MARILZA MAIA-HERZOG

Simuliidae and Onchocerciasis Research Programme, Biomedical Sciences Theme, Department of Entomology, The Natural History Museum, Cromwell Road, SW7 5BD, London, UK.

Email: luh@nhm.ac.uk; ajs@nhm.ac.uk

Departamento de Entomologia, Instituto Oswaldo Cruz, Rio de Janeiro, RJ, Brasil.

Email: apalunadias@hotmail.com; mherzog@ioc.fiocruz.br

Abstract

In this paper, the female, male, and pupa of *S. itaunense* D'Andretta & González B. are redescribed based on material collected from the state of Rio Grande do Sul. The affinities of *S. itaunense* with other South American simuliid species are discussed and its distribution, biology, and medical importance in Brazil are presented. The adults of *S. itaunense* are externally most similar to those of *S. guianense* Wise (species complex), *S. orbitale* Lutz, and *S. perplexum* Shelley, Maia-Herzog, Luna Dias & Couch, but they can be easily identified by the structure of the male and female genitalia. The pupa is readily distinguished by the number of filaments, which vary from 45 to 56. *Simulium itaunense* has only been recorded from Brazil, where the immature stages can be found in small rivers with clear water and sandy river beds. They have also been found on Podostemaceae and on rocks in fast-flowing streams. The females bite horned [sic] cattle in Rio Grande do Sul.

Key words: Simuliidae, Neotropical Region, taxonomy, *Simulium itaunense*, *Trichodagmia*, Brazil

Introduction

Species of the Neotropical subgenus *Trichodagmia* Enderlein (*sensu* Crosskey & Howard 1997, 2004) are found from southeastern Brazil to Amazonia. They also occur in the Guyanas, from southern Venezuela to western South America, extending to Paraguay, Colombia, and Argentina (Miranda-Esquivel & Coscarón 2001). This subgenus includes 14 species, one of which, *S. guianense* Wise, is known to be a species complex and the primary vector of river blindness in Brazil (Charalambous *et al.* 1996; Shelley 2002). Several others are highly anthropophilic (*S. nigrimanum* Macquart) or are a biting nuisance to

both humans and cattle (*S. lahillei* (Paterson & Shannon), *S. orbitale* Lutz, and *S. scutistriatum* Lutz) (Miranda-Esquivel & Coscarón 2001).

In their cladistic analysis of the subgenera *Trichodagmia* and *Thyrsopelma*, Miranda-Esquivel and Coscarón (2001) stated that the relationship between the species of what they called “the *orbitale* species group” required further investigation after the discovery of the larval stage of *S. perplexum* Shelley, Maia-Herzog, Luna Dias & Couch and the female of *S. itaunense* D’Andretta & González B. *Simulium itaunense* was described by D’Andretta & González B. (1964) based on a single male and its pupa. It has remained poorly known and scarce in collections since its original description. Further work has provided more morphological information. Py-Daniel *et al.* (1985) described the larva of this species, Coscarón (1991) all stages [with no figures] except the female, and more recently, Strieder (2004) described the female, but a comprehensive description with accurate figures still does not exist. In the current paper, the female, male, and pupa of *S. itaunense* are fully redescribed and digitally illustrated based on material collected in the state of Rio Grande do Sul. We also document the variation in the pupal gill configuration and discuss the affinities of *S. itaunense* with closely related simuliid species of the subgenus *Trichodagmia* in Latin America and record its distribution, biology, and medical importance in Brazil. No larvae were available for redescription of this stage.

Material and Methods

The standard techniques for collection, conservation, measurement, and the terminology used in the species description are those detailed in Shelley *et al.* (1997, 2000, 2002). Dissections were carried out following a modified technique routinely used by colleagues in the Mosquitoes Research Programme at the Natural History Museum (NHM). Dried pinned adults were left in a relaxing box overnight to soften and then dissected the following day. In those specimens that were link-reared, the pupal pelts stored in glycerine were first rinsed in water for 10–15 min and then transferred to 80% alcohol together with the respective emerged adults. All specimens were individually dissected in 80% alcohol. The adult head, thorax, and abdomen were placed in hot 10% KOH for 10–15 min. These body parts were then rinsed in water for 5–10 min and after two changes of 80% alcohol, all unwanted body tissues and membranes were removed. The head, thorax, and abdomen were placed together with the remaining parts of the adult body and pupa, transferred to Cellosolve (2-Ethoxyethanol) for 10–15 min and mounted on a cavity slide using Euparal® as the mounting medium. The adult genitalia and the female cibarium were dissected in a small drop of Phenolic Gum Copal (D.J. & D. Henshaw supplier). The slide was left to dry overnight and then a coverslip with a drop of Euparal® was placed on top the following morning. Images illustrating the morphology were obtained directly from a Synoptic digital imaging system as detailed in Shelley *et al.* (2000). The system has now been upgraded with the Olympus BX 50 compound and Wild 5A stereo microscopes

equipped with a JVC-KY70 digital camera that produce high quality images of 1289 X 1019 pixels of 4 mb. The images are stored in the NHM Simuliid Digital Archive and on CDs. All material has been deposited in the Department of Entomology of the Natural History Museum, London (BMNH) and the Simuliidae collection of the Instituto Oswaldo Cruz, Brazil (IOC). The holotype of *S. itaunense* was not found in the Museu de Zoologia, Universidade de São Paulo, Brazil (MZUSP). Type material of *Thyrsopelma brasiliense* Enderlein (a synonym of *S. orbitale*) is housed in the Museum für Naturkunde der Humboldt-Universität, Berlin, Germany (NMHU).

Description

Simulium (Trichodagmia) itaunense D'Andretta & González B.

(Figs. 1–23)

Simulium itaunensis D'Andretta & González B., 1964:106–108. HOLOTYPE ♂ no. 856 (reared), BRAZIL: São Paulo State, Itatinga (Fazenda Itaúna); 17.vii.1957 (C. D'Andretta Jr.) (MZUSP).

FEMALE. General body colour black. Body length (specimen in alcohol) 4.2 mm (n = 1), (specimens pinned) 2.9–3.4 mm (mean = 2.9 mm, s.d. = 0.17, n = 3); wing length 2.8–3.1 mm (mean = 2.9 mm, s.d. = 0.17, n = 3), wing width 1.4–1.5 mm (mean = 1.5 mm, s.d. = 0.09, n = 3).

Head — dichoptic with dark red eyes and nudiocular area well developed (Fig. 1). Frons, clypeus and occiput black, with silvery grey pruinosity; clypeus and frons covered with recumbent white setae interspersed with dark, semi-erect black setae. Mouthparts dark brown to black. Antennae black with scape and pedicel dark brown. Cibarium unarmed or with undeveloped tubercles in the central trough, some of which have extremely fine denticles (only visible at high magnification); cornuae well developed and sclerotised (Fig. 2). [Strieder (2004) stated that the cibarium in this species is armed with small tubercles (see Fig. 4, page 295), but these were not seen in one specimen in the material we studied.]

Thorax — scutum black, covered by recumbent, white setae. Scutal pattern varying only slightly with illumination. With anterior illumination, thorax black; humeri brownish with faint grey pruinosity; lateral and posterior margins black (Fig. 3). With posterior illumination, thorax black with grey pruinosity on anterior two thirds of scutum; lateral and posterior margins black (Fig. 4). Humeri brownish and weakly pruinose. Scutellum black with recumbent white setae interspersed with long, black bristles. Postnotum black with silver pruinosity. Pleura dark brown to black with silver pruinosity. Costa of wing with sparse distribution of spines and setae. Subcosta with only six setae in basal half (only setae insertions were visible in the single dissected specimen examined). Radius with line of setae intermixed with spines; basal section of Radius with hairs arranged in double



1

2

5



3

4

8



6

7

Simulium itaunense female. Fig. 1: nudiocular area. Fig. 2: cibarium. Fig. 3: scutal pattern (light source anterior). Fig. 4: scutal pattern (light source posterior). Fig. 5: anterior wing veins. Fig. 6: fore, mid, and hind legs. Fig. 7: claw of mid leg. Fig. 8: abdomen.

line on basal third (Fig. 5). Basal tuft of long, dark setae. Leg coloration and proportions as in Fig. 6. Foreleg with coxa, trochanter, and femur pale brown, tibia with basal and apical third and tarsal segments dark brown, pale yellow mesally. Mid and hind legs with coxae, apex of hind femur, apex of mid and hind tibiae and basitarsal segments I and II dark brown; trochanters, mid femur, basal half of hind femur, and basal half of mid and hind tibiae yellowish brown; basal two thirds of basitarsal segments I and II pale yellow. Claws curved without distinct basal tooth (Fig. 7). Halteres cream with brown base.

Abdomen — tergites I–IX shiny black, covered with recumbent white setae; tergite I silver pruinose on anterolateral margin (Fig. 8). Tergal plates developed; sternal plates undeveloped. Sternites greyish black; genitalia black. Eighth sternite sclerotised with irregularly distributed setae on posterior margin; gonapophyses crescent shaped, well developed, and touching centrally with apices curved in anterior direction, membranous and rounded distally, highly setose over entire surface (Fig. 9). Cerci subhemispherical, covered with brown setae; paraproct subtriangular, nearly same length as cercus, with small membranous process with hairs and setae and weakly sclerotised laterally; paraproct covered with prominent brown setae interspersed with small setae (Fig. 10). Genital fork stout and sclerotised; termination of lateral arms with anterior margin straight and developed; anterior and posterior processes well developed (Fig. 11). Spermatheca globular, without external sculpturing and with single spicules on internal surface; area of insertion of spermathecal duct weakly sclerotised, two fifths maximum width of spermatheca.

MALE. General body colour black. Body length (specimens pinned) 3.4–3.9 mm (mean = 3.7 mm, s.d. = 0.19, n = 4), wing length 2.7–2.9 mm (mean = 2.8 mm, s.d. = 0.06, n = 4), wing width 1.3–1.6 mm (mean = 1.4 mm, s.d. = 0.14, n = 4).

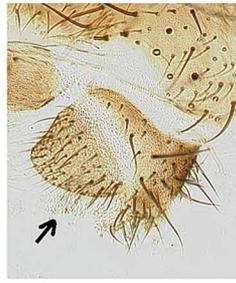
Head — holoptic with dark red eyes. Rest of head coloration as in female.

Thorax — scutum black with grey pruinosity, covered with golden, recumbent hairs. Scutal pattern, irrespective of light direction, consisting of 1 + 1 submedian, rounded silver pruinose vittae on anterior one third (Figs 12–13) [pattern more distinct with posterior light source]. Humeri weakly silver pruinose; lateral and posterior margins of scutum black [light source anterior or posterior], weakly silver pruinose when specimens viewed at an angle. Scutellum black with recumbent golden hairs interspersed with long, erect black hairs on posterior margin. Postnotum black with silvery grey pruinosity. Wing setation as in female, except Subcosta with fewer setae. Leg coloration as in female except legs darker brown.

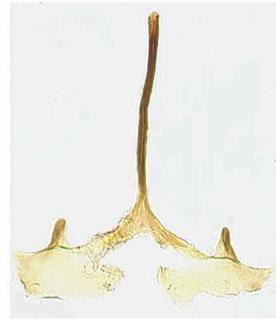
Abdomen — tergites black, distinctly covered by golden, recumbent hairs; basal fringe with long, brown hairs (Fig. 14). Silver pruinose ornamentation on abdominal segments as follows: anterior margin of tergites IV and V [in dorsal view] and anterolateral margin of segments II and V–VII [best seen when specimen viewed laterally]. Genitalia black; tergal plates poorly developed and sternal plates well developed. Gonocoxite subquadrangular; gonostyle spindle-shaped, 3.5 times longer than length of gonocoxite at midpoint, with



9



10



11



12



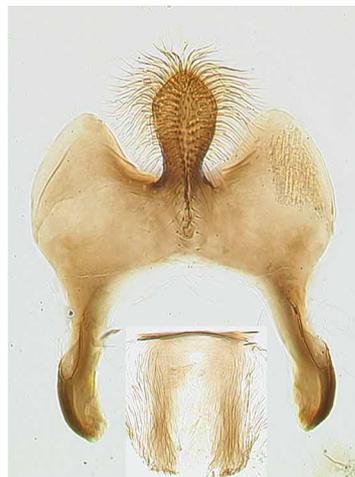
13



14



15



16



17

Simulium itaunense female and male. Female: Fig. 9: eighth sternite and gonapophyses. Fig. 10: cercus and paraproct. The arrow indicates the small membranous process. Fig. 11: genital fork. Male: Fig. 12: scutal pattern (light source anterior). Fig. 13: scutal pattern (light source posterior). Fig. 14: abdomen. Fig. 15: gonocoxite and gonostyle; inset, detail of apical spine. Fig. 16: ventral plate and median sclerite. Fig. 17: paramere.

single, stout spine [sometimes with another smaller one]; gonocoxite and gonostyle covered with long setae (Fig. 15). Ventral plate sclerotised, with well-developed lateral shoulders, prominent, median, pear-shaped process arising from anterior margin covered with long hairs; basal arms straight, sclerotised and weakly narrow apically (Fig. 16). Median sclerite prominent, ovoid, nearly as long as width of ventral plate, with distinct incision to half of its length (Fig. 16). Paramere weakly sclerotised and poorly developed with no spines (Fig. 17).

PUPA. Cocoon length dorsally 3.7–4.3 mm (mean = 4.0 mm, s.d. = 0.21, n = 9), ventrally 4.5–4.9 mm (mean = 4.7 mm, s.d. = 0.14, n = 9); pupa length 4.1–5.5 mm (mean = 4.9 mm, s.d. = 0.39, n = 9); gill length 0.7–1.2 mm (mean = 0.9 mm, s.d. = 0.17, n = 11).

Cocoon shoe shaped as in Figs. 18–19, light to dark brown composed of thick coalesced fibres, with reinforced rim to anterior aperture; margin of aperture weakly elevated.

Gill light brown with 45–56 upwardly directed filaments arranged in bunch in vertical plane [specimens with 50 filaments are common]. Gill configuration with main trunk short, giving rise to four sets of primary branches, three external and one internal (Figs 20–21). Primary branches bifurcate farther into secondary branches that are highly variable in number of filaments, all branching at different heights. In gills with the lowest number of filaments, the configuration is as follows: most dorsal of external branch often with 17 filaments, median 8 and ventral 7; internal set of filaments often consisting of 14 filaments. Variation of this pattern occurs on all primary branches. Filaments stout, pointed, and highly sclerotised distally, edges weakly crenate; all filaments approximately same length.

Head with 2 + 2 frontal and 1 + 1 simple, spiniform, facial trichomes; frontoclypeus with distinct group of platelets mesally, 1 + 1 dorso-laterally and 2–3 platelets in groups of 2 laterally in frontal region, respectively; tubercles rounded, densely distributed in facial region and absent from frontal region (Fig. 23).

Thorax with 4 + 4 distinct spiniform trichomes near margin of dorsal cleft (Fig. 22) and 2 + 2 simple trichomes on central region of thorax; tubercles mostly rounded on ventral margin near base of gill and pointed on posterior part of dorsal margin.

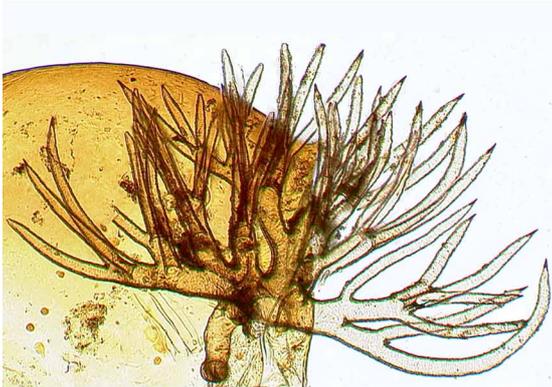
Abdominal tergite I with spine combs on posterior margin; tergite II with 3 + 3 submedian and 1 + 1 sublateral spiniform setae in longitudinal row and 1 + 1 long, simple setae anterior to most lateral of spiniform setae; tergites III and IV with 4 + 4 submedian, simple hooks in longitudinal row, sometimes 1 + 1 small, simple setae anterior to most lateral of hooks and 1 + 1 small, simple setae laterally; tergites V–VII with 1 + 1 small, simple setae laterally; tergite IX weakly sclerotised, without terminal spines. Groups of spine combs on anterior margin of tergites I–VIII. Abdominal sternite III with 1 + 1 submedian and 2 + 2 sublateral, small, simple setae; sternite IV with 2 + 2 submedian, spiniform setae; sternite V with 2 + 2 submedian, close bifid hooks; sternites VI–VII with 2 + 2 well-separated and bifid hooks. Abdominal sternites III–VIII with groups of spine combs on anterior margin.



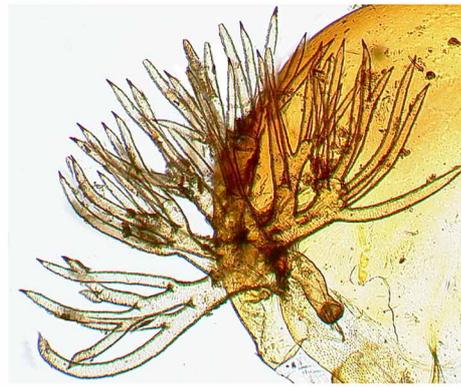
18



19



20



21



22



23

Simulium itaunense pupa. Fig. 18: cocoon (lateral view). Fig. 19: cocoon (dorsal view). Fig. 20: right gill. Fig. 21: left gill. Fig. 22: spiniform thoracic trichomes. Fig. 23: frontoclypeus, inset showing frontal and facial trichomes, and tubercles.

Taxonomic discussion

The classification of the subgenus *Trichodagmia* is unstable, as several authors recognise *Grenieriella* Vargas & Díaz Nájera and *Thyrsopelma* Enderlein as valid genera (e.g., Py-Daniel & Moreira Sampaio 1994a, b, 1995; Strieder 2004) or consider them as separate subgenera (Coscarón 1987, 1991; Miranda-Esquivel & Coscarón 2001). All these names are treated as synonyms of *Trichodagmia* by Crosskey and Howard (1997, 2004), which is followed in this paper for the placement of *S. itaunense*. The classification of *Trichodagmia* and other subgenera occurring in Brazil in relation to the Neotropical blackfly fauna will be reviewed in a forthcoming revision of the Simuliidae of Brazil.

Simulium itaunense was described by D'Andretta and González B. (1964), based on a reared male collected in Itatinga (Fazenda Itaúna), state of São Paulo on 17.viii.1957 by C. D'Andretta, Jr. The holotype is said to be deposited at the Faculdade da Farmácia e Odontologia (now Museu de Zoologia), Universidade de São Paulo, and is mounted on three slides (Coscarón 1991). We were unable to locate the holotype in the Museu de Zoologia collection. Also, the authors have been incorrectly cited as D'Andretta and Dolores González, 1964. The correct citation should be D'Andretta & González B. because Dolores is the Christian name of the second author.

Miranda-Esquivel and Coscarón (2001) grouped *S. itaunense* together with *S. guianense*, *S. hirtipupa* Lutz, *S. orbitale*, *S. perplexum*, and *S. scutistriatum* in *Thyrsopelma*. Within this group, *S. itaunense* is externally most similar to *S. guianense*, *S. orbitale*, and *S. perplexum* by having a black thorax, without pattern and covered by recumbent whitish setae (Figs. 3–4), but they can be distinguished by the structure of the cercus and paraproct. In *S. itaunense*, a weak membranous process occurs on the paraproct (Fig. 10), but it is not a tail-like projection emerging from beneath the paraproct (inner surface) and projecting ventrally as in *S. guianense* (Shelley *et al.* 2000, Fig. 76; Shelley *et al.* 2004, Fig. 24). In addition, the cercus in *S. itaunense* is relatively subhemispherical (Fig. 10) while in *S. guianense* it is relatively subrectangular. *Simulium orbitale* is easily identified by the subquadrangular paraproct, weakly sclerotised dorsally with two distinct internal, setose, tail-like projections on the membranous part. In *S. perplexum*, the paraproct is broadly rectangular and in place of the tail the paraproct is extended and doubled under, ventrally (Shelley *et al.* 2004, Fig. 25).

The male genitalia of *S. itaunense*, *S. guianense*, and *S. orbitale* are similar, especially in the ventral plate, which has a median pear-shaped process covered by long hairs. However, *S. itaunense* is easily distinguished from the two other species by the pear-shaped process arising from the anterior margin of the ventral plate (Fig. 16) and the presence of 1 + 1 silver pruinose rounded vittae on the anterior third of the scutum (Figs. 12–13) [irrespective of light source direction]. In *S. guianense* and *S. orbitale*, the pear-shaped process arises from or close to the ventral margin but in *S. guianense* the lateral arms are expanded apically and weakly sclerotised, whereas in *S. orbitale* the lateral arms are narrower apically and distinctly sclerotised [Shelley *et al.* 2004, Fig. 89]. Furthermore, the males of these

two species can be externally distinguished by the scutal pattern. With light source anterior, the scutum in *S. guianense* is mostly covered by a silver ornamentation, except for a broad, black, median vitta that runs from the anterior border posteriorly for about three quarters of the scutal length and 1 + 1 lateral oval areas in the central part of the scutum (Figs. 95–96 in Shelley *et al.* (2000); Shelley *et al.* 2004, Fig. 63). In *S. orbitale*, with the same light source orientation, the scutum is brownish black with 1 + 1 broad, silver vittae beginning on the anterolateral margins and running diagonally towards the midline of the scutum and ending in the posterior third of the thorax.

Simulium itaunense can be further recognised by the number of the pupa gill filaments, which vary from 45 to 56 (Figs. 20–21) compared with 20 to 23 in *S. orbitale*. D'Andretta & González B. (1964) in their description of the pupa of *S. itaunense* recorded 50 gill filaments on one side and 49 on the other in the holotype, with each gill varying in the number of filaments present in each secondary branch. Both *S. guianense* and *S. perplexum* have 12 gill filaments, but they can be distinguished by the shape of the annulations on the distal part of the gill. In *S. guianense*, the apex of the gills is less accentuated with spicules, whereas in *S. perplexum* the gills are distinctly accentuated with forwardly directed processes (Shelley *et al.* 2004, Figs. 109–112).

Distribution

Simulium itaunense has only been recorded in Brazil from the states of Rio Grande do Sul, Santa Catarina and São Paulo (Crosskey & Howard 1997, 2004; Strieder, 2004; Material Examined).

Biology and medical importance

In Brazil, the immature stages of *S. itaunense* are found in small rivers (3 m wide) with clear water and sandy river beds (A.J.Shelley & A.P.A.Luna Dias, unpublished data). Strieder (2004) recorded the larvae and pupae on Podostemaceae and on underwater rocks in fast-flowing, clear-water streams. He also stated that the females of *S. itaunense* bite horned [sic] cattle in Rio Grande do Sul.

Acknowledgements

The authors would like to thank Furnas Centrais Elétricas, CNPq, and FUNASA for financial support during this study.

References

- Charalambous, M., Shelley, A.J., Maia-Herzog, M., Luna Dias, A.P.A. (1996) Four new cytotypes of the onchocerciasis vector blackfly *Simulium guianense* in Brazil. *Medical and Veterinary Entomology*, 10, 111–120.
- Coscarón, S. (1987) *El género Simulium Latreille en la Región Neotropical: Análisis de los Grupos Supraspecíficos, Especies que los Integran y Distribución Geográfica (Simuliidae, Diptera)*. Museu Paraense Emílio Goeldi, 112 pp.
- Coscarón, S. (1991) *Fauna de Agua Dulce de la República Argentina. 38. Insecta, Diptera. 2. Simuliidae*. vi + 7–304 [+ 67 figures on unnumbered pages], Fundación para la Educación, la Ciencia y la Cultura, Buenos Aires.
- Crosskey, R.W. & Howard, T.M. (1997) *A New Taxonomic and Geographical Inventory of World Blackflies (Diptera: Simuliidae)*. The Natural History Museum, London, 144 pp.
- Crosskey, R.W. & Howard, T.M. (2004) *A New Taxonomic and Geographical Inventory of World Blackflies (Diptera: Simuliidae)*. The Natural History Museum, London, 82 pp. [web version: <http://www.nhm.ac.uk/entomology/projects/blackflies/Inventory.pdf>] [accessed in Jan. 2005]
- D'Andretta, C., González, B.D. (1964) Três novas espécies brasileiras de Simuliidae (Diptera Nematocera). *Memórias do Instituto Butantan*, 30, 103–116.
- Miranda-Esquivel, D.R. & Coscarón, S. (2001) Cladistic analysis of *Simulium (Trichodagmia)* and *Simulium (Thyrsopelma)* (Diptera: Simuliidae). *Zoological Journal of the Linnean Society*, 132, 429–439.
- Py-Daniel, V., Konrad, H.G. & Gastal, H.A.O. (1985) Simuliidae (Diptera, Culicomorpha) no Brasil. IV. Descrição das larvas de *Simulium (Psaroniocompsa) brevifurcatum* Lutz, 1910; *S. (P.) anamariae* Vulcano, 1962; *S. (Thyrsopelma) itaunense* D'Andretta & Dolores Gonzáles, 1962. *Iherengia, Série Zoologia, Porto Alegre*, 65, 95–102.
- Py-Daniel, V. & Moreira Sampaio, R.T. (1994a) *Jalacingomyia* gen.n. (Culicomorpha); a ressurreição de Gymnopauidinae; a eliminação do nível tribal; apresentação de novos caracteres e a redescoberta dos estágios larval e pupal de *Simulium colombaschense* (Fabricius, 1787) (Diptera: Simuliidae). *Memórias del CAICET*, 4, 101–148.
- Py-Daniel, V. & Moreira Sampaio, R.T. (1994b) Atualização nomenclatural para Simuliidae Neotropical (Diptera, Culicomorpha, Simuliidae). *Memórias del CAICET*, 4, 149–156.
- Py-Daniel, V. & Moreira Sampaio, R.T. (1995) Gêneros e espécies de Simuliidae (Diptera: Culicomorpha) assinalados para o Brasil até 1995. *Entomología y Vectores*, 2, 117–121.
- Shelley, A.J. (2002) Human onchocerciasis in Brazil: an overview. *Cadernos de Saúde Pública*, 18, 1167–1177.
- Shelley, A.J., Hernández, L.M. & Penn, M. (2002) A biosystematic revision of the blackflies (Diptera: Simuliidae) of Belize, Central America. *Bulletin of the Natural History Museum (Entomology)*, 71, 135–271.
- Shelley, A.J., Hernández, L.M. & Davies, J.B. (2004) Blackflies (Diptera: Simuliidae) of Southern Guyana with Keys for the Identification of Adults and Pupae- A Review. *Memórias do Instituto Oswaldo Cruz*, 99, 443–470.
- Shelley, A.J., Lowry, C.A., Maia-Herzog, M., Luna Dias, A.P.A. & Moraes, M.A.P. (1997) Biosystematic studies on the Simuliidae (Diptera) of the Amazonia onchocerciasis focus of Brazil. *Bulletin of the Natural History Museum (Entomology)*, 66, 1–121.
- Shelley, A.J., Maia-Herzog, M., Lowry, C.A., Luna Dias, A.P.A., Garritano, P.R., Shelley, A., Camargo, M. & Carter, H.G. (2000) The Simuliidae (Diptera) of the secondary onchocerciasis focus at Minaçu in Central Brazil. *Bulletin of the Natural History Museum (Entomology)*, 69, 171–221.
- Strieder, M.N. (2004) Description of the female of *Thyrsopelma itaunense* (Diptera, Simuliidae). *Revista Brasileira de Entomologia*, 49, 293–296.

Material Examined

The material of all species we have examined for this paper is listed in alphabetical order.

***Simulium (Trichodagmia) guianense* Wise, 1911 (species complex)**

The material listed under *S. guianense s.l.* in Shelley *et al.* (1997, 2000, 2004) was examined for this paper.

***Simulium (Trichodagmia) itaunense* D'Andretta & González B., 1966**

BRAZIL

Rio Grande do Sul

PINNED

Arroio Lageado I, Br 392, (site 874); 20.viii.1992, (A.J.Shelley, A.P.A.Luna Dias & P.R.Garritano) — 2 ♀♀ 5 ♂♂ (reared, 1 ♂ with pupa on slide, 2 ♀♀ with head on slide) (BMNH; IOC).

SLIDE

Arroio Lageado I, Br 392, (site 874); 20.viii.1992, (A.J.Shelley, A.P.A.Luna Dias & P.R.Garritano) — 1 ♀ 1 ♂ (reared), 1 ♂ (reared but no associated with pupa), 2 ♀♀ (only head, remaining pinned), 2 pupae (BMNH).

SPIRIT

Arroio Lageado I, Br 392, (site 874); 20.viii.1992, (A.J.Shelley, A.P.A.Luna Dias & P.R.Garritano) — 3 pupae (BMNH).

***Simulium (Trichodagmia) orbitale* Lutz, 1909**

TYPE MATERIAL

BRAZIL

Minas Gerais

PINNED

B. Constant; 2.10, [Without collector's name.] — 1 ♀ (only thorax and one wing; head, one wing, abdomen, legs and genitalia on slide) [NEOTYPE, no. 405] (IOC).

SLIDE

B. Constant; 2.10, [Without collector's name.] — 1 ♀ (only head, one wing, abdomen, legs and genitalia; adult and one wing pinned) [NEOTYPE, no. 405] (IOC).

Paraná

PINNED

Cataratas do Iguaçu, Garganta do Diabo; 7.vii.1944, (Vulcano Andretta & D'Andretta Jr) — 1 ♂ (reared) [As NEOALOTYPE] (IOC).

As Thyrsopelma brasiliense Enderlein, 1934

ZOOTAXA

896

BRAZIL

[Without State.]

PINNED

[As Brasilien, Without locality.]; [Without date.], (Sello) — 1 ♀ (only thorax; head, wings, abdomen, genitalia and legs and legs on slide) [SYNTYPE, no. 6835] [White label here added “Type-1”.] (NMHU). Same data as syntype — 1 ♀ (only head, thorax, left wing and five legs; abdomen, one hind leg and right wing on slide) [SYNTYPE, no. 8] (NMHU).

SLIDE

[As Brasilien, Without locality.]; [Without date.], (Sello) — 1 ♀ (only head, wings, abdomen, genitalia and legs and legs; thorax pinned) [SYNTYPE, no. 6835] [White label here added “Type-1”.] (NMHU). Same data as syntype — 1 ♀ (abdomen and one hind leg and right wing on slide; adult pinned) [SYNTYPE, no. 8] (NMHU). Same data as syntype — 1 ♀ (specimen in bad condition being mounted between two coverslips, with Enderlein’s handwriting on each side) [SYNTYPE, no. 6835] (NMHU).

OTHER MATERIAL

ARGENTINA

Misiones Province

PINNED

Ao. S.O. de B. de Irigoyen; 2.xi.1981, (S.Coscarón) — 1 ♂ (reared) (BMNH). Rio Iguazú, Cataratas; 10.xi.1980, (S.Coscarón) — 1 ♀ (reared) (BMNH).

BRAZIL

Minas Gerais

PINNED

Cachoeira Canaã, Município de Carmo de Minas, (site 1204); 6.iii.1997, (A.P.A.Luna Dias) — 1 ♀ (reared, pupa on slide) (BMNH).

SLIDE

Cachoeira Canaã, Município de Carmo de Minas, (site 1204); 6.iii.1997, (A.P.A.Luna Dias) — 1 ♀ (pupa, adult pinned) (BMNH).

Paraná

PINNED

Foz do Iguaçu, Iguaçu National Park; 9.xi.1980, (A.J.Shelley) — 2 ♀♀ 1 ♂ (reared; pupa, wings and legs on slide) (BMNH).

SLIDE

Foz do Iguaçu, Iguaçu National Park; 9.xi.1980, (A.J.Shelley) — 2 ♀♀ 1 ♂ (only pupa, wings and legs; adult pinned) (BMNH).

Rio Grande do Sul

SPIRIT

São Nicolão; 9.i.1999, (S.Coscarón) — 4 pupae (BMNH).

São Paulo

PINNED

Piraçicaba, (no. 1041); 28.vii.1944, (Vulcano Andretta & D'Andretta Jr) — 1 ♀ (reared, pupa on slide) (MZUSP). Caieiras, Tancão, (site 818); 12.xii.1990, (M.MHerzog, A.P.A.Luna Dias, P.R.Garritano & C.Coutinho) — 1 ♀ 3 ♂ (reared) (IOC).

SLIDE

Piraçicaba, (no. 1041); 28.vii.1944, (Vulcano Andretta & D'Andretta Jr) — 1 pupa (female adult pinned) (MZUSP).

***Simulium (Trichodagnia) perplexum* Shelley, Maia-Herzog, Luna Dias & Couch, 1989**

The material listed under *S. perplexum* in Shelley *et al.* 2004 was examined for this paper.