

The Simuliidae (Diptera) of the secondary onchocerciasis focus at Minaçu in central Brazil.

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- A.J. SHELLEY**
Biomedical Sciences Theme, Department of Entomology, The Natural History Museum, London, UK.
- M. MAIA-HERZOG**
Departamento de Entomologia, Instituto Oswaldo Cruz, Rio de Janeiro, Brasil.
- C.A. LOWRY**
Biomedical Sciences Theme, Department of Entomology, The Natural History Museum, London, UK.
- A.P.A. LUNA DIAS**
Departamento de Entomologia, Instituto Oswaldo Cruz, Rio de Janeiro, Brasil.
- P.R. GARRITANO**
Departamento de Entomologia, Instituto Oswaldo Cruz, Rio de Janeiro, Brasil.
- A. SHELLEY**
Biomedical Sciences Theme, Department of Entomology, The Natural History Museum, London, UK.
- M. CAMARGO**
Departamento de Entomologia, Universidade Federal de Goiás, Goiás, Brasil.
- H.G. CARTER**
Biomedical Sciences Theme, Department of Entomology, The Natural History Museum, London, UK.

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SYNOPSIS. The simuliid fauna of Minaçu, Goiás in the central Planalto region of Brazil was studied as part of a year long project to investigate the possible presence of a focus of onchocerciasis at this locality. Descriptions of the adults and pupae, identification keys to adults and pupae and distributional data are given for the ten species collected (*Simulium auripellitum*, *S. cuasiexiguum*, *S. exiguum*, *S. guianense*, *S. incrustatum*, *S. lutzianum*, *S. minusculum*, *S. nigrimanum*, *S. spinibranchium* and *S. subpallidum*).

Key words: Simuliidae, *Simulium*, blackflies, biosystematics, onchocerciasis, Brazil

INTRODUCTION

Onchocerciasis was first reported thirty years ago in Yanomami indians who live in an area of rain forest straddling the frontiers of southern Venezuela and north western Brazil and drained by tributaries of the Orinoco and Amazon rivers. Studies over the following two decades on the epidemiology of the disease in this Amazonia focus, its vectors and its transmission are reviewed in Shelley (1988) and Shelley *et al.* (1997). In Brazil the disease had remained restricted to this area because of its extreme isolation until visits were made by tin miners, who later carried the disease some 2000kms south to Minaçu, in Goiás State, and formed a secondary onchocerciasis focus. Minaçu (13°35'S 48°18'W) (Fig. 1) is a small town in central Brazil that was founded about 30 years ago and has rapidly developed as a result of asbestos extraction, gold mining and the construction of a major hydroelectric dam on the nearby R. Tocantins. It lies in an area of dense savanna (cerrado) and hence has a different simuliid fauna to that in the Amazonia onchocerciasis focus. Details of parasitological studies in this area are given by Maia-Herzog *et al.* (1999).

A prerequisite to incriminating vector *Simulium* species in newly discovered foci of human onchocerciasis is the prospection for Simuliidae to determine the species present in the area and to provide a guide to their identification, distribution and biology. This information will indicate the anthropophilic and hence potential vector species in the area and, following vector incrimination studies, suggest possible distribution patterns for the disease and its dispersal. This paper records the simuliid species present in the area of Minaçu, provides brief descriptions of adults and pupae, identification keys, local distribution sites and country distributions for the Neotropical region. Although many larvae were collected, and have been deposited in the BMNH and IOC, this stage has not been dealt with in this paper because it is not immediately relevant to determining potential vector identities.

MATERIALS AND METHODS

Collections were made initially in the dry season of 1986 (July), at the beginning of the wet season in 1991 (October), and in the dry season of 1992 (May, June). From the beginning of the dry season 1995 (March) until the dry season of 1996 (July) monthly sampling at four collection stations provided data on seasonal population fluctuations of the simuliid species (Fig. 1) and sporadic collections were also made at other sites near Minaçu from then until 1998. A one hour prospection of the submerged riverine vegetation and rocks was made each month at each station for larvae and pupae but elsewhere sites were only sampled qualitatively. Larvae and immature pupae were preserved in 80% ethanol and mature pupae were link-reared to adults and preserved in ethanol or pinned using the techniques detailed in Shelley *et al.* (1997). Monthly collections of anthropophilic females at the four catching stations were made on three consecutive days using two individuals clad in shorts, who alternated on an hourly basis between catching and acting as bait. In order to sample all the anthropophilic species present, collections were made during daylight hours, starting at 0700 hours and continuing until dark at 1900 hours local time. Flies were collected directly in 80% alcohol and stored as hourly samples for subsequent identification. Voucher specimens of all the species collected have been deposited in the Entomology Departments of the Instituto Oswaldo Cruz (IOC), Rio de Janeiro and The Natural History Museum (BMNH), London.

Descriptions are arranged in alphabetical order by subgenus. Figures of *Simulium* species have been prepared using a composite image analysis system developed by 'Synoptics', Cambridge, UK (Lowry, Shelley & Town, 1996) and have been stored on CD discs in the Simuliidae archives in the BMNH and IOC. This system has been specifically developed for this study and overcomes the focussing problems caused by depth of field that previously precluded photography of three dimensional structures such as

the scutum for its pattern and genitalia and mouthparts morphology. The system, consisting of a computer, colour video camera and compound microscope, captures images of these structures at different focal depths and then forms a composite image by combining the focussed portions of each image. A wide spectrum of magnifications can be used ranging from a 4× or 10× objective for scutal patterns to 100× objective for genitalia. The software consists of a 'Windows' based application 'Montage' using the 'PC' image processing language 'Semper'. This is used in conjunction with a 'Sprynt' colour framestore board, which produces images at the maximum possible resolution from a TV camera system. An 'Olympus BX 50' optical microscope is equipped with a 'Sony' colour camera, which is linked to 'Sprynt' to produce high quality colour images digitised to 768 × 576 pixels to be displayed on an image monitor and captured to disk (archived at 512 × 512 pixels). The programme is also linked to an image archiving system 'Treasury', which allows rapid comparison of stored images. Data transfer can then be made through the Internet, thereby obviating the need to exchange specimens by post with the attendant risks of damage. Most figures are in black and white but natural colours were captured from pinned specimens of the male abdomen, and the male and female scutum. Leg patterns were captured from material mounted directly in Berlese mountant from dry specimens or freshly preserved spirit material and hence coloration changes have been minimised.

Measurements were made using a camera lucida. Body lengths for adults and pupae were measured from material in a lateral position in glass beads within a watchglass containing 70% ethanol. Body lengths of dry specimens were used when material was only available in this condition and this has been indicated in the text. Gill and wing dimensions were measured from specimens in alcohol or slide mounted. Wings from pinned specimens were only used if few specimens were available. Definitions of the dimensions used are detailed in Shelley *et al.* (1997) and the terminology used in that paper is followed here, except that the term tubercles substitutes for platelets in descriptions of pupae. The term nudiocular area is used here (after Crosskey, 1990; Fig. 20) to indicate the area of the eye lacking ommatidia and equivalent to the fronto-ocular triangle of other authors.

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KEYS TO THE SIMULIID SPECIES OF MINAÇU

Ten species of Simuliidae were collected: *Simulium spinibranchium* and *S. subpallidum* of the subgenus *Chirostilbia*, *S. cuasiexiguum* and *S. exiguum* of the subgenus *Notolepria*, *S. auripellitum*, *S. incrustatum*, *S. minusculum* of the subgenus *Psaroniocompsa*, *S. lutzianum* of the subgenus *Psilopelmia*, *S. guianense* and *S. nigrimanum* of the subgenus *Trichodagmia*. The subgeneric classification of Crosskey and Howard (1997) has been followed. The following keys have been produced for identification of females, males and pupae and short descriptions of these stages are then given for each species to further facilitate identification. Colours of adults have been based on pinned specimens. Colours of specimens recently preserved in alcohol will remain true but this method of preservation produces colour changes and leaching with time. Black species may become brown after a few years, orange after a few decades and eventually transparent. The pigment of brown and orange species reacts similarly with time. Characters used in the key to pupae have been selected to ensure identification of most specimens. Species such as *S. incrustatum* with long filamentous gill filaments suffer considerable gill damage during preservation and examination and also in the breeding grounds. Therefore, it is not usually possible to obtain a specimen with perfect gill filaments. Consequently, we have avoided the length of gill as a character wherever possible. In the descriptions, the ranges of gill length given are based on the shortest filament and longest filament for each gill measured.

Females

1. Thorax orange or grey 2
 - Thorax brown or black 3
2. Thorax orange without pattern (Fig. 46) *lutzianum*
 - Thorax orange or grey with faint pattern consisting of a median and 1+1 submedian grey or white longitudinal lines (depending on light direction) (Figs. 33, 34) *subpallidum*
3. Thorax brown to brownish black with no pattern (Fig. 48) *nigrimanum*
 - Thorax black with or without pattern 4
4. Thorax black without pattern 5
 - Thorax black with pattern 7
5. Thorax with evenly distributed white setae; legs mainly black and brown banded, eye with nudiocular area present (Figs. 19, 47, 56) *guianense*
 - Thorax with groups of silvery gold setae appearing green in some lights; legs mainly yellow with some dark bands

- on hind leg, nudiocular area absent (Figs. 13, 35, 51) 6
6. Paraproct with well developed, stout anterior process (Fig. 70) **exiguum**
- Paraproct with fine, curved anterior process (Fig. 71) ... **cuasiexiguum**
7. Thoracic pattern poorly developed, consisting of 1+1 submedian silver triangles on anterior border of scutum (with posterior light source) 8
- Thoracic pattern well developed, covering all of scutum 9
8. Scutum with 1+1 submedian, black triangles on anterior surface (with anterior light source) and with numerous, brass coloured hairs evenly distributed over whole surface (Figs. 38, 40); subcostal wing vein without setae (sometimes 1 or 2 fine setae present); claws of legs generally without basal spines **auripellitum**
- Scutum with no submedian black triangles obvious (with anterior light source) and with numerous silvery hairs forming longitudinal median line and grouped in clumps that form broken lines running length of scutum and diverging from mid line (Fig. 42); subcostal wing vein without setae*, claws with basal spine as in *nigrimanum* (Fig. 3) **incrustatum**
9. Thoracic pattern in form of 1+1 silver, submedian bands running from anterior to posterior border of scutum; 1+1 black triangles with tails visible at certain angles on anterior border of these bands (anterior light source) (Fig. 44), triangles silver with posterior light source (Fig. 45), lateral and posterior borders silver **minusculum**
- Thoracic pattern in form of black or silver grey (depending on light direction) lyre occupying three fourths length of scutum (Figs. 31, 32) **spinibranchium**
5. Setae on scutum densely and evenly distributed 6
- Setae on scutum arranged in groups 7
6. Legs mainly whitish yellow, hind femora whitish yellow with distal fourth dark brown (Figs. 49, 87) **spinibranchium**
- Legs mainly dark brown, hind femora with basal half cream and distal half dark brown (Fig. 52, scutum as in Fig. 90 but without silver triangles) **auripellitum***
7. Setae on scutum silvery and arranged in groups that form broken lines running length of scutum and diverging laterally from mid line; legs mainly dark brown with white bands (Figs. 53, 91) **incrustatum**
- Setae on scutum golden with green reflections (Fig. 89); legs mainly yellow (Fig. 51) 8
8. Gonostyle subtriangular with small distal spine (Fig. 100); ventral plate with reduced basal arms (Fig. 110) **exiguum**
- Gonostyle square with small blunt spine on distal inner corner (Fig. 101); ventral plate with well developed basal arms (Fig. 111) **cuasiexiguum**
9. Scutum silver pruinose with large black anchor design with anterior light source (Fig. 95) or with thick median and 1+1 disc-shaped, submedian black bands with posterior light source (Fig. 96) **guianense**
- Scutum mainly black with silver ornamentation 10
10. Scutum with 1+1 submedian, silver pruinose lines running for up to two thirds scutal length from anterior scutal border (Fig. 92, 93) **minusculum**
- Scutum with 1+1 submedian silver pruinose triangles on anterior border (Fig. 90) **auripellitum***

Males

1. Thorax orange without pattern 2
- Thorax black or brown 3
2. Scutum with anterior and posterior borders silver pruinose [best seen when specimens tilted]; legs brownish black except for most of posterior basitarsus, which is yellowish brown [as female] (Figs. 55, 94) **lutzianum**
- Scutum with 1+1 silver pruinose patches on anterior border [best seen when specimen tilted] lateral border pruinose, legs banded, mainly yellowish [as female] (Figs. 50, 88) **subpallidum**
3. Thorax dark brown (Fig. 97) **nigrimanum**
- Thorax black 4
4. Scutum without pattern 5
- Scutum with pattern 9
1. Gill with six filaments 2
- Gill with more than six filaments 4
2. Filaments fine, long and most distal branching in median part (Figs. 131, 132) **auripellitum, incrustatum**
- Filaments thicker, branching near base 3
3. Tubercles widely and densely distributed on frontoclypeus and cephalothorax (as in *exiguum*) (Figs. 130, 146) **cuasiexiguum**
- Tubercles few and mainly on dorsal surface of cephalothorax (Figs. 134, 147) **minusculum**
4. Gill with eight filaments 5
- Gill with more than eight filaments 8
5. Gill filament width broader at base, becoming progressively finer towards tip; branching of filaments basal, gill resembling stag's antlers (Fig. 127) **spinibranchium**

Pupae

*Based on small number of specimens; at other localities in Brazil setae may be present on median part of vein or along its entire length.

**S.auripellitum* usually occurs with silver triangles on scutum, sometimes silver triangles absent.

- Gill filament width approximately the same along filaments' lengths; branching of filaments at variable distance from base 6
- 6. Cocoon brown, of open weave or closely meshed fibres. Gill with filaments branching near base, most distal bifurcations at about one fifth gill length 7
- Cocoon white, gelatinous with thickened dorsal ridge. Gill with filaments branching more distally, most distal bifurcations at about two fifths gill length (Fig. 135, 140) *lutzianum*
- 7. Cocoon with open weave (Fig. 139). Trichomes of frontoclypeus simple or bifid (rarely with 3 branches) (Fig. 142). Tubercles densely distributed (Fig. 146) *exiguum*
- Cocoon with closely meshed fibres (Fig. 138). Trichomes of frontoclypeus bifid to 5-branched (Fig. 141). Tubercles sparsely distributed (as in *minusculum*) (Fig. 147) *subpallidum*
- 8. Gill with 12 filaments, these with pointed tips (Fig. 136) *guianense*
- Gill with 18–20 filaments, these with rounded tips (Fig. 137) *nigrimanum*

SPECIES DESCRIPTIONS, DISTRIBUTION AND BIOLOGY

Simulium (Chirostilbia) spinibranchium Lutz

(Figs. 11, 21, 31, 32, 49, 58, 68, 78, 87, 98, 108, 118, 127)

A species of limited distribution in highland areas of Brazil and southern Venezuela (Material examined; Coscarón, 1991), described in detail by Py-Daniel and Shelley (1980).

FEMALE. General body colour black. No specimens preserved in alcohol from the area of Minaçu were available for measurement. Dimensions from pinned material are: body length 1.9–2.8mm (\bar{X} =2.3mm, s.d.=0.29, n=7), wing length 2.4–3.1mm (\bar{X} =2.7mm, s.d.=0.21, n=9), wing width 1.1–1.4mm (\bar{X} =1.2mm, s.d.=0.14, n=10). Dimensions for this species recorded by Py-Daniel and Shelley (1980) are: body length of dried specimens 2.3–2.5mm, wing length 2.9–3.0mm.

Head – dichoptic with dark red eyes, nudiocular area present (Fig. 11). Rest of head black with grey pruinosity, mouthparts and maxillary palps brown. Cibarium unarmed and with well developed lateral cornuae (Fig. 21).

Thorax – brownish black. Scutum black with silver pruinosity and black lyre shaped pattern with anterior light source (Fig. 31); with posterior light source lyre-

shaped pattern silver-grey on black scutum (Fig. 32). Subcostal wing vein and basal sector of radius haired as in Fig. 2. Leg proportions and coloration as in Fig. 49; all femora and tibiae with scales as in Fig. 4; claws with small basal tooth as in Fig. 3.

Abdomen – tergites shiny dark brown, tergite II with a small central area silver pruinose, sternites greyish brown, genitalia light brown. Gonopophyses small, lightly sclerotised on inner margin and glabrous (Fig. 58). Paraprocts well developed, subrectangular (Fig. 68). Genital fork robust and sclerotised, with triangular anteriorly directed processes (Fig. 78). Spermatheca sclerotised with rows of inner spicules as in Fig. 7 and small membranous area at insertion of spermathecal duct as in Fig. 5.

MALE. General body colour black. No alcohol preserved specimens were available from the Minaçu area for measuring. Dimensions from pinned material are: body length 1.9–2.7mm (\bar{X} =2.4mm, s.d.=0.28, n=5), wing length 2.1–2.8mm (\bar{X} =2.5mm, s.d.=0.24, n=6), wing width 1.0–1.3mm (\bar{X} =1.1mm, s.d.=0.15, n=4). Dimensions given in Py-Daniel and Shelley (1980) are as follows: body length 1.9–3.8mm (alcohol preserved), 2.3–2.7mm (pinned), length of wing 2.7mm.

Head – holoptic with dark red eyes. Other head coloration as in female.

Thorax – velvet black with posterior, lateral and outer thirds of anterior borders silver pruinose (Fig. 87). Coloration of rest of thorax as in female. Wing venation as in female except subcostal vein without setae.

Abdomen – tergites black with the following silver ornamentation: tergites II and V silver except for median section, tergites VI and VII with 1+1 large, lateral, silver marks. Genitalia black. Gonocoxite almost square, gonostyle small, almost rectangular with no distal spine (Fig. 98). Ventral plate with reduced basal arms, triangular, lightly sclerotised except for basal margin and keel (Fig. 108). Median sclerite pear-shaped with distal incision (Fig. 108). Paramere with well developed spines distally (Fig. 118).

PUPA. Cocoon length dorsally 1.9–2.2mm (\bar{X} =2.0, s.d.=0.17, n=3), ventrally 1.9–2.9mm (\bar{X} =2.3mm, s.d.=0.49, n=3), pupa length 2.1–3.3mm (\bar{X} =2.6mm, s.d.=0.31, n=18), gill length 1.8–2.3mm (\bar{X} =2.1mm, s.d.=0.22, n=5).

Cocoon light brown, slipper shaped as in Fig. 9, gelatinous with slightly reinforced rim to anterior aperture and no central protuberance. Gill dark brown with eight forwardly directed filaments arranged in four primary branches, three in a plane external to the fourth in the form of two cupped hands in a vertical plane. Filaments wide at base and tapering distally, collectively in form of stag's antlers (Fig. 127). Primary branches in outer plane consisting of a dorsal with two secondary branches, an unbranched median

and a ventral with two secondary branches. Primary branch in inner plane with three branches that lie behind the median primary branch of the outer primary branches. Secondary branching at various levels in basal fourth of gill.

DISTRIBUTION AND BIOLOGY. In the area of Minaçu this species was uncommon, found attached to vegetation in two smaller rivers (Table 1, Fig. 148). Elsewhere the species has a restricted distribution, being recorded from small rivers in highland areas of central and southern Brazil and southern Venezuela (Material examined; Coscarón, 1991; Py-Daniel & Shelley, 1980; Ramírez Pérez, 1983). The species has never been recorded biting man.

Simulium (Chirostilbia) subpallidum Lutz

(Figs. 12, 22, 33, 50, 59, 69, 79, 88, 99, 109, 119, 128, 141, 147)

A full description of *S. subpallidum* is given by Coscarón (1982) together with comparisons with its nearest relatives *S. acarayense* and *S. papaveroi*. Synonyms of this species and its subgeneric placing and distribution are given by Coscarón (1982, 1987, 1991) and Ramírez Pérez (1983).

FEMALE. General body colour orange-brown and grey. Body length 1.7–2.6mm (\bar{X} =2.1mm, s.d.=0.25, n=11), wing length 1.7–2.2mm (\bar{X} =1.9mm, s.d.=0.18, n=10), wing width 0.7–1.0mm (\bar{X} =0.84mm, s.d.=0.13, n=10).

Head – dichoptic with greenish eyes, nudiocular area present (Fig. 12). Cibarium unarmed (Fig. 22). Rest of head grey pruinose, except for light brown antennae and mouthparts.

Thorax – orange-brown, except for black postnotum. With anterior light source scutum divided into four, wide faintly pruinose longitudinal bands produced by a median and 1+1 submedian, posteriorly diverging darker lines (Fig. 33). With posterior light source these lines become faintly pruinose and the bands lose their pruinosity (Fig. 34). A grey form also occurs showing a similar but more obvious pattern reversal in relation to light direction. Subcostal wing vein with a central seta and basal sector of Radius with a line of setae (variation in wing hairing has been noted by Coscarón & Wygodzinsky (1972), the basal sector of the Radius having 1 or 2 rows of setae and the Subcostal vein without setae or with a single line of setae along its length). Legs yellowish with brown coloration as follows: fore leg tarsus, part of mid leg coxa, distal tips of femur, tibia and basitarsus of hind leg. Proportions of legs as in figure 50; claws without teeth.

Abdomen – greenish grey. Genitalia grey. Gonophyses small, unsclerotised and quadrangular (Fig. 59) Paraprocts triangular, three times as long as width at base (Fig. 69). Genital fork unsclerotised with

well developed lateral arms with triangular anterior processes (Fig. 79). Spermatheca oval, highly sclerotised with no obvious external sculpturing and small area of insertion of spermathecal duct as in Fig. 5.

MALE. General body colour orange and brown. Body length 1.9–2.8mm (\bar{X} =2.3mm, s.d.=0.36, n=7), wing length 1.5–1.9mm (\bar{X} =1.7mm, s.d.=0.13, n=7), wing width 0.7–0.9mm (\bar{X} =0.8mm, s.d.=0.09, n=7).

Head – holoptic with red eyes; rest of coloration as in female.

Thorax – orange with silver pruinose areas as follows: 1+1 submedian patches on anterior border (Fig. 88) and all of lateral and posterior borders of scutum (seen when specimen tilted); postnotum black with silver pruinose triangular areas on anterior border extending for half its length. Wing venation and leg coloration as in female except dark areas more intense.

Abdomen – tergites I, II and IX greenish brown, other segments velvet black with silver ornamentation as follows: all except median band of tergite II, lateral borders of tergites VI and VII and all of tergite IX. [Silver ornamentation appears to vary – in specimens from Argentina and Paraguay (as *guarani*) only segments VI and VII have silver patches (Coscarón and Wygodzinsky 1972), whereas in a description formulated from these specimens and extra material collected in Brazil the abdomen is described as black with silver patches on tergites II, VI and VIII (Coscarón, 1991).] Genitalia black. Gonocoxite rectangular, wider than long, gonostyle small, rectangular, longer than wide, with no distal spine (Fig. 99), ventral plate subtriangular, not pointed with fine sclerotised basal arms, small keel and fine hairs (Fig. 109). Median sclerite Y-shaped and sclerotised (Fig. 109). Paramere with several well developed apical spines (Fig. 119).

PUPA. Cocoon length dorsally 2.2–2.7mm (\bar{X} =2.5mm, s.d.=0.14, n=19), ventrally 2.2–2.9mm (\bar{X} =2.6mm, s.d.=0.21, n=20); pupa length 1.8–2.8mm (\bar{X} =2.1mm, s.d.=0.31, n=8), gill length 1.2–1.9mm (\bar{X} =1.6mm, s.d.=0.23, n=16). Cocoon slipper-shaped as in Fig. 9, mid brown, made of finely woven gelatinous fibres (Fig. 138) and with a reinforced rim to the anterior aperture without central protuberance. Gill yellowish with rounded ends on the eight, fine, basally branching, forwardly-directed filaments arranged in a vertical plane. Main trunk giving rise to three primary branches with the following divisions into secondary branches in basal sixth of gill: dorsal and median with three and ventral with two branches (Fig. 128). Trichomes on cephalothorax and frontoclypeus 2–5 branched (Fig. 141), tubercles sparsely distributed as in *S. minusculum* (Fig. 147) – on cephalothorax confined to gill base and dorsal area, and absent on frontoclypeus except for base of frons.

DISTRIBUTION AND BIOLOGY. *Simulium subpallidum* commonly occurs in all river types in the area of Minaçu (Table 1, Fig. 148). It has also been recorded from other localities in Goiás and from the states of Bahia, Espírito Santo, Mato Grosso do Sul, Minas Gerais, Pará, Paraná, Pernambuco, Roraima and São Paulo (Material examined; Coscarón, 1987, 1991)[BMNH and IOC collections] as well as from Paraguay, Argentina and Venezuela (Coscarón & Wygodzinsky, 1972; Ramírez Pérez 1971, 1983). In Minaçu *S. subpallidum* is totally zoophilic and there are no published records of this species biting man elsewhere. Female *S. subpallidum* have been observed swarming at dusk over the R.Una in Pernambuco State in Brazil prior to ovipositing (Shelley *et al.*, 1995).

Simulium (Notolepria) exiguum Roubaud complex

(Figs. 5, 8, 23, 35, 51, 60, 70, 80, 89, 100, 110, 120, 129, 139, 142, 146)

A widespread species complex in Latin America first described by Roubaud from females collected in northern Venezuela. A detailed description of the morphospecies and its synonyms are given in Shelley *et al.* (1997). *Simulium exiguum* s.l. is used in this paper since there is a paucity of information on cytospecies distributions and no morphological characters are available to distinguish these cytospecies

FEMALE. General body colour black. Dimensions from pinned material: body length – 1.4–1.9mm (\bar{X} = 1.6mm, s.d.=0.16, n=10), wing length 1.7–2.0mm (\bar{X} = 1.8mm, s.d.=0.12, n=13), wing width 0.8–1.0mm (\bar{X} = 0.9mm, s.d.=0.05, n=12). [Dimensions recorded for this species by Shelley *et al.* (1997) in Amazonia were: body length 1.6–2.6mm, wing length 1.4–2.0mm, wing width 0.6–1.0mm.]

Head – dichoptic with dark red eyes showing green highlights, nudiocular area absent (Fig. 13). Rest of head black with silver pruinosity, mouthparts and antennae brown. Cibarium unarmed (Fig. 23).

Thorax – greyish black with one median and a pair of posteriorly divergent, submedian, darker black lines running whole length of scutum; scutum covered with numerous, short, adpressed, dark setae and discrete groups of brass-coloured setae with greenish reflections that are absent along the mid-line (Fig. 35). Wings with Subcostal vein and basal sector of Radius bare. Legs yellow to light brown, except fore tarsi, mid and hind coxae, distal three quarters of hind femora and distal half to three quarters of hind tibiae black (Fig. 51); all femora and tibiae with scales as in Fig. 4. Proportion of legs as in Fig. 51; claws curved, without basal tooth, except on hind leg as in Fig. 3.

Abdomen – tergites shiny, brownish black with silver pruinosity on second segment, sternites brownish black,

genitalia light brown. Gonopophyses small, slightly pointed and weakly sclerotised on inner margin, glabrous (Fig. 60). Paraprocts broadly rectangular, almost as wide as long with well developed, triangular, anteriorly-directed process (Fig. 70). Genital fork slender with triangular sclerotised anteriorly directed processes and sclerotised stem (Fig. 80). Spermatheca oval, highly sclerotised with no external sculpturing and width of membranous area of insertion of spermathecal duct about half maximum width of spermatheca (Fig. 5).

MALE. General body colour black. Dimensions from pinned specimens: body length – 1.4–1.6mm (\bar{X} = 1.5mm, s.d.=0.08, n=3), wing length 1.6–1.9mm (\bar{X} = 1.7mm, s.d.=0.11, n=5), wing width 0.8mm (\bar{X} = 0.8mm, s.d.=0.02, n=4). [Dimensions recorded for this species by Shelley *et al.* (1997) in the Amazonia onchocerciasis focus were: body length 1.6–2.4mm, wing length 1.2–1.8mm, wing width 0.6–0.9mm]

Head – holoptic with dark red eyes, smaller facets with green reflections. Other head coloration as in female.

Thorax – velvet black, with anterior and posterior margins and anterior two thirds of lateral margin of scutum silver pruinose (seen when specimen tilted); scutum with numerous, short, adpressed, brown setae and groups of brilliant gold setae (Fig. 89). Wing venation and leg coloration as in female.

Abdomen – tergites velvet black with silver ornamentation as follows: tergites II, VI and VII completely silver except for median area in VI (sometimes) and VII; tergite VIII with a pair of lateral silver patches on posterior margin; tergite IX shiny black (Fig. 8). Genitalia brownish black. Gonocoxite subrectangular; gonostyle small, subtriangular, one third as long as gonocoxite and with small distal spine (Fig. 100). Ventral plate triangular with reduced basal arms, lightly sclerotised, with hairs on keel short, diffuse and mainly around median part (Fig. 110). Median sclerite Y-shaped (Fig. 110). Paramere with several apical spines (Fig. 120).

PUPA. Cocoon length dorsally and ventrally and pupa length – no material available; gill length 1.2–1.5mm (\bar{X} = 1.4mm, s.d.=1.5, n=5) [Dimensions recorded for this species by Shelley *et al.* (1997) in the Amazonia onchocerciasis focus were: cocoon length dorsally 1.9–2.5mm, ventrally 2.1–3.1mm, pupa length 1.7–2.6mm, gill length 1.1–1.7mm]

Cocoon slipper-shaped as in Fig. 9, mid to dark brown, composed of fine fibres (Fig. 139), with reinforced rim to anterior aperture without central protuberance. Gill light brown, with eight forwardly directed slender filaments arranged in vertical plane (Fig. 129). Main trunk giving rise to three primary branches, ventral with two filaments and median and dorsal each with three filaments; ventral branch with

basal bifurcation in basal fourth of gill, median branch with first bifurcation in basal fourth and second bifurcation in basal third of gill, dorsal branch with first bifurcation basally and second bifurcation in basal fourth of gill. Frontoclypeus with simple or bifid trichomes (rarely 3-branched) (Fig. 142) and tubercles densely distributed (Fig. 146).

DISTRIBUTION AND BIOLOGY. This species was uncommon in the area, being found in low numbers only in rivers between 5–30 metres in width (Table 1, Fig. 148). Pupae were attached to dead leaves in parts of the river with a faster current. *Simulium exiguum* s.l. has been collected biting man occasionally, being largely zoophilic in the area. Elsewhere in Brazil both anthrophilic and zoophilic populations occur with breeding in medium to large fast flowing rivers in both lowland and highland areas in the Federal District and states of Amazonas, Goiás, Mato Grosso, Roraima and São Paulo (Material examined; Shelley *et al.*, 1997). *Simulium exiguum* s.l. is a widespread Neotropical species also found in Argentina, Bolivia, Colombia, Ecuador, Guatemala, Mexico, Panama, Peru, and Venezuela (Coscarón, 1991; Ramírez Pérez, 1983; Shelley, Arzube & Couch, 1989). This species is a complex of several cytotypes (Charalambous, Shelley & Arzube, 1993) in Ecuador, four of which are efficient hosts to *O. volvulus* (Shelley, Charalambous & Arzube, 1990). It is also the primary vector of onchocerciasis in this country (Shelley & Arzube, 1985). Several different cytotypes of *S. exiguum* probably occur in Brazil and this species may be a vector of onchocerciasis in the Amazonia focus.

Simulium (Notolepria) cuasiexiguum Shelley, Luna Dias, Maia-Herzog & Lowry

(Figs. 6, 61, 71, 101, 111, 130)

This species is closely related to *S. exiguum* being different from it in the following characters. A more comprehensive description is given in Shelley *et al.*, In press).

FEMALE. Body length 1.5–2.3mm (\bar{X} =1.8mm, s.d.=0.2, n=6), wing length 1.5–2.1mm (\bar{X} =1.7mm, s.d.=0.16, n=6), wing width 0.7–1.0mm (\bar{X} =0.8mm, s.d.=0.07, n=6). Eighth sternite heavily sclerotised along whole width, gonopophyses pointed and heavily sclerotised on inner margins (Fig. 61). Paraproct about half as wide as long with anterior process fine and curved (Fig. 71). Area of insertion of spermathecal duct not membranous but highly sclerotised and in some cases sclerotisation also involving basal part of spermathecal duct (Fig. 6).

MALE. Body length 1.9–2.2mm (\bar{X} =2.0mm, s.d.=0.06, n=3). Gonostyle square with small, blunt spine on distal, inner corner (Fig. 101); ventral plate

more quadrangular with apex more produced and pointed, sclerotised with well developed basal (Fig. 111).

PUPA. Cocoon length dorsally 2.1–2.7mm (\bar{X} =2.2mm, s.d.=0.09, n=10), ventrally 2.2–3.1mm (\bar{X} =2.4mm, s.d.=0.16, n=13), pupa length 2.0–2.1mm (\bar{X} =2.0mm, s.d.=0.05, n=10), gill length 1.3–1.5mm (\bar{X} =1.4mm, s.d.=0.12, n=4). Gill with six forwardly-directed filaments arranged in the vertical plane; main trunk giving rise to three primary branches, dorsal branch with bifurcation at base, median and ventral branches with bifurcations in basal fifth of gill (Fig. 130).

DISTRIBUTION AND BIOLOGY. *Simulium cuasiexiguum* has a very limited distribution in the Planalto region of Brazil in northern Goiás and is present at one locality in the Mato Grosso. It occurs in low numbers on submerged vegetation in small to medium size (10–100m), fast flowing rivers in the cerrado (Table 1, Fig. 2; Material examined). The species is apparently zoophilic.

Simulium (Psaroniocompsa) auripellitum Enderlein

(Figs. 7, 14, 15, 24, 25, 36, 37, 38, 39, 40, 41, 52, 62, 72, 81, 90, 102, 112, 121, 131, 143, 144)

This species has often been confused with *S. incrustatum*. Using characters discussed by Coscarón & Wygodzinsky (1984), plus new characters described below, *S. auripellitum* is now seen to be one of the most common and widespread species in Brazil.

FEMALE. General body colour black (brown in older faded specimens). Body length 1.6–2.2 mm (\bar{X} =1.8 mm, s.d.=0.24, n=6); wing length 1.4–1.7 mm (\bar{X} =1.6 mm, s.d.=0.08, n=10); wing width 0.4–0.8mm (\bar{X} =0.7 mm, s.d.=0.13, n=10).

Head – dichoptic with dark red eyes (appearing black in dried specimens); nudiocular area slightly developed (Fig. 14) as in *S. incrustatum* or absent (Fig. 15) in specimens with the ‘anchor form’ of scutal pattern. Frons, clypeus and occiput black with silvery grey pruinosity and scattered, short, black hairs. Mouthparts dark brown, antennae black, except scape and pedicel, light brown to orange. Cibarium with highly sclerotised posterior margin and deep central trough with central area invaginated and covered in blunt tubercles; 1+1 groups of teeth either side of trough extending on to base of cornuae in both typical forms (Fig. 24) and those with an ‘anchor pattern’ on the scutum (Fig. 25).

Thorax – scutum and humeri velvet black, sometimes with faint, median pale line. Pair of submedian triangles, as wide at maximum width as long, on anterior scutal border and extending for one fourth of scutal length. Triangles black with anterior light source

(Fig. 38) and silver pruinose with posterior light source (Fig. 39). In some specimens a silver pruinose sheen covers the anterior fourth of the scutum forming an anchor shape (Fig. 40), most easily seen if the light source is either anterior or placed at right angles to the surface of the scutum; this anchor pattern disappears with a posterior light source (Fig. 41). Posterior and lateral margins of scutum and humeri silver pruinose. Paranotal folds velvet black with silver pruinosity. Scutum with numerous recumbent, brass-coloured hairs evenly distributed over all scutal surface. Subcostal wing vein and basal sector of radius bare (occasionally specimens show 1 or 2 fine setae in middle of subcosta). Fore legs with coxa, trochanter and femur mid to dark brown, tibia pale to mid brown, tarsus dark brown to black; outer face of tibia white pruinose. Mid leg coxa, trochanter, femur and tibia mid to dark brown; distal articulation of femur, basal articulation of tibia, basitarsus and basal half of second tarsal segment white and rest of tarsus brown; outer face of tibia white pruinose. Hind leg brownish black with basal half of femur, basal third to half of tibia, basal three quarters of basitarsus and basal half of second tarsal segment cream (Fig. 52). Tarsi narrow, femora and tibiae of all legs with scales as in Fig. 4. Claws curved, rarely with small basal tooth as in Fig. 3.

Abdomen – tergites I–V velvet black, VI–IX shiny black. Sternites and genitalia dark brown to black. Eighth sternite sclerotised with a group of 3 poorly developed setae and 4–8 well developed setae on each side; gonopophyses small, membranous and setose, with light sclerotisation at base of inner margin (Fig. 62). Cerci hemispherical, paraprocts subrectangular with small underlying flap on outer margin (Fig. 72). Genital fork (Fig. 81) thin with sclerotised stem, well developed, slightly sclerotised lateral processes on arms, and fine anterior processes. Spermatheca oval with well developed internal spicules arranged in groups (Fig. 7). Area of insertion of spermathecal duct membranous (Fig. 7) and between one third and a quarter the maximum width of spermatheca.

MALE. General body colour black. Body length 1.6–2.4 mm ($\bar{X}=1.9$ mm, s.d.=0.4, n=3), wing length 1.4–1.6 mm ($\bar{X}=1.5$ mm, s.d.=0.14, n=2), wing width 0.7–0.8 mm ($\bar{X}=0.8$ mm, s.d.=0.05, n=2), dimensions from pinned specimens – wing length 1.5–1.6 mm ($\bar{X}=1.55$ mm, s.d.=0.04, n=9), wing width 0.8–0.9 mm ($\bar{X}=0.8$ mm, s.d.=0.03, n=9).

Head holoptic with upper eye facets dark red and lower eye facets darker red (appearing black in dried specimens). Rest of head coloration as in female.

Scutum velvet black with recumbent, evenly distributed, golden hairs and 1+1 submedian silvery white, pruinose triangles on anterior border (Fig. 90). In some specimens triangles apparently absent. Humeri velvet black with silver pruinosity in narrow band across

anterior margin. Scutum with posterior and lateral margins pruinose as in female [best seen with specimen tilted]. Coloration of paranotal folds and pleural area as in female except silver pruinosity more developed. Coloration and setation of scutellum and postnotum as in female.

Wing venation, leg and halter coloration as in female.

Abdominal tergites velvet black, basal fringe of long black hairs. Silver pruinose ornamentation as follows: tergite II completely silver except for median area, tergites VI–VIII with lateral margins silver, more developed in VI. Genitalia dark brown, sternites brownish grey; sternal plates well developed. Gonocoxite approximately as long as wide; gonostyle short, slightly longer than wide, and about quarter size of gonocoxite, with prominent subterminal spine (Fig. 102). Ventral plate lightly sclerotised with thick basal arms, keel area covered in thick, fleshy spines rather than hairs, most developed towards apex (Fig. 112). Median sclerite pyriform with apical incision (Fig. 112). Paramere with large distal group of at least 20 tightly packed spines of varying size (Fig. 121).

PUPA. Cocoon length dorsally 1.8–2.3 mm ($\bar{X}=2.1$, s.d.=0.15, n=8); ventrally 1.6–2.4 mm ($\bar{X}=2.1$, s.d.=0.25, n=8); pupa length 1.6–2.7 mm ($\bar{X}=2.1$ mm, s.d.=0.28, n=14); gill length 1.1–3.5 mm ($\bar{X}=2.1$ mm, s.d.=0.45, n=60).

Cocoon slipper-shaped as in Fig. 9, light to dark brown; rim of aperture slightly reinforced, without central protuberance. Cocoon delicate, composed of elastic, amorphous substance interwoven with fibres. Gill light brown with six forwardly-directed long, slender filaments; primary branches in vertical plane and dorsal and median secondary branches in approximately same horizontal plane with ventral branch below (Fig. 131). Main trunk of gill giving rise to two primary branches near base; dorsal primary branch with very basal bifurcation, each primary filament further bifurcating generally at about same level in about middle of gill; ventral primary branch with bifurcation in basal third of gill length; filaments slender, rounded distally, their surfaces covered in fine spicules and margins crenate. Head (frontoclypeus) with 2 + 2 well developed simple frontal trichomes (posterior median to anterior) and 1 + 1 well developed bifid facial trichomes in female pupae giving rise to females with normal scutal patterns (Fig. 143), but trichomes simple in females with anchor type scutal patterns (Fig. 144); surface of head covered with tubercles as in Fig. 146. Thorax with 5 + 5 well-developed bifid trichomes, 2 + 2 simple well developed trichomes beneath gill base towards margin and 1 + 1 simple trichomes centrally; surface of thorax covered with tubercles, more densely distributed in anterior half. Abdominal tergite I with 1 + 1 simple hairs laterally, marginally nearer anterior

than posterior border; tergite II with 2+2 simple hairs in line along postero-central region of segment and 1+1 groups of 2-3 simple hairs at lateral end of line; tergites III-IV with 4+4 simple hooks and 1+1 weak hairs above (and sometimes inside) most lateral; tergites VI-VIII with patches of well-developed spines and spine combs on antero-lateral margins; tergite IX with 1+1 strong, unbranched terminal spines and antero-lateral patch of spines and spine combs. Abdominal sternites III-IV with central patch of fine spine combs, extending over most of segment in sternite IV; sternite V with 2+2 simple or bifid hooks towards posterior border; sternites VI-VII with 4+4 evenly spaced simple or bifid hooks and 1+1 large patches of spine combs above and outside inner two; sternite VIII with wide band of fine spine combs.

TAXONOMIC DISCUSSION. *Simulium auripellitum* was first described by Enderlein (1934) from a female holotype collected by Schrottky biting man at Hohenau in Paraguay. The description covers too few characters for its identification today, but Coscarón and Wygodzinsky (1984) provide further details, based on an examination of the type and material from Argentina, Brazil and Paraguay, for its characterisation within the subgenus *Psaroniocompsa*. Their paper groups *auripellitum* with *jujuyense*, *bonaerense* and *angrense* in having similar tomentum and silver submedian cuneiform marks on the scutal border, and distinguishes this group from *incruiatum*, which has the scutal setae arranged in packets in divergent, longitudinal lines. The minor morphological differences between *jujuyense*, *bonaerense* and *auripellitum* suggest possible synonymy with *jujuyense* as the senior synonym. However, cytological and morphological investigations are necessary before this can be clarified. Following our examination of the holotype (Figs. 36, 37), and of reared material from Brazil and Paraguay, we have been able to observe variation in the density of the tomentum in females and the level of pruinosity on the anterior scutal border in females of *auripellitum* and these have been figured (Figs. 38-41). We have included the 'anchor pattern' variant as *auripellitum* because only slight variations in the nudiocular triangle, cibarium and pupal trichomes distinguish it from the typical form. We have also studied the holotype (female pupal skin) and description and figures of *S. angrense* in Pinto (1932). Figure 15 in Pinto (1932) and the description of the frontoclypeus are inaccurate. Examination of the slide-mounted holotype shows that the left and right anterior facial trichomes are bifid, the left posterior facial trichome is trifid while the right one is missing; the left frontal trichome is bifid and the right is missing (Fig. 145). Although no trifid trichomes were observed in *S. auripellitum* or *S. incruiatum* this character alone is considered rather marginal for species separation. The branching pattern of the gill of

S. angrense (Fig. 133) also falls within the variation that occurs in both *S. auripellitum* and *S. incruiatum* but because it is considerably longer (4.3mm) than the other two species (1.1-3.5mm and 2.2-3.8mm respectively) we maintain it as a valid species.

DISTRIBUTION AND BIOLOGY. *Simulium auripellitum* was found in many smaller streams and a relatively large river at Minaçu (Table 1; Fig. 148). In Brazil it is a widely distributed species in smaller rivers in southern and central states (Material examined; Coscarón, 1987, 1991). It has also been recorded from Argentina, Bolivia, Paraguay (type locality) and Uruguay (Material Examined; Coscarón, 1987, 1991; Coscarón and Wygodzinsky, 1984). This species breeds in small streams and rivers attached to submerged vegetation (Coscarón, 1991) and is anthropophilic. In Brazil, streams in forested areas are favoured and only small numbers of specimens are ever found in rivers or biting man.

Simulium (Psaroniocompsa) incruiatum Lutz

(Figs. 16, 26, 42, 43, 53, 63, 73, 82, 91, 103, 113, 122, 132)

This species is closely related to *S. auripellitum* and so only distinguishing features are given here. A full description of *S. incruiatum* is given by Shelley *et al.* (1997).

FEMALE. General body colour black (brown in older faded specimens). Dimensions from pinned specimens: body length 1.4-1.9mm (\bar{X} =1.6mm, s.d.=0.17, n=9); wing length 1.6-2.1mm (\bar{X} =1.8mm, s.d.=0.13, n=16); wing width 0.8-1.0mm (\bar{X} =0.9mm, s.d.=0.05, n=16).

Head - nudiocular area slightly developed (Fig. 16) as in normal form of *S. auripellitum* (Fig. 14). Cibarium (Fig. 26) similar to that in both forms of *S. auripellitum* (Figs. 24, 25) except central trough slightly wider.

Thorax - scutum and humeri velvet black (with anterior light source) (Fig. 42) and with pair of submedian, silver pruinose triangles, as wide at maximum width as long, on anterior scutal border and extending for one fourth of scutal length with posterior light source (Fig. 43). Posterior and lateral margins of scutum and humeri silver pruinose (most easily seen when specimen tilted). Paranotal folds velvet black with silver pruinosity. Scutum with numerous recumbent, brass-coloured hairs forming a longitudinal median line running length of scutum, and grouped in clumps that form broken lines running the length of the thorax and that diverge from the midline in the direction of the posterior margin (Figs. 42, 43). Subcostal wing vein without setae in central part in most localities but in Santa Catarina and São Paulo states of Brazil specimens occur in which setae may be present

on the median part of the vein or along its entire length. Legs (Fig. 53) as in *S. auripellitum* (Fig. 52) but usually with small basal tooth as in Fig. 3 for *S. nigrimanum*.

Abdomen – Eighth sternite (Fig. 63) similar to *S. auripellitum* (Fig. 62). Paraprocts (Fig. 73) of same basic shape but more sub-rectangular than in *S. auripellitum* (Fig. 72). Genital fork (Fig. 82) similar to that of *S. auripellitum* (Fig. 81), except lateral arms with expanded distal membranous areas.

MALE. General body colour black. Body length 2.1mm (n=1), wing length 1.6–1.7mm (\bar{X} = 1.7mm, s.d.=0.04, n=5), wing width 0.8–0.9mm (\bar{X} =0.8mm, s.d.=0.03, n=5).

Coloration as in male of *S. auripellitum* except as follows:

Scutum velvet black with recumbent, silvery golden hairs many of which are wider in anterior half; hairs grouped in clumps as in female and arranged in longitudinal lines diverging laterally; sublateral silver triangles absent (Fig. 91). Silver pruinose ornamentation of abdomen as in *S. auripellitum* except in specimens from the type locality in São Paulo State in which silver areas also occur on tergites IV–V. Genitalia (Figs. 103, 113) as in *S. auripellitum* (Figs. 102, 112,) except paramere with less spines and different sequence of sizes (Figs. 122, 123).

PUPA. Cocoon length dorsally 2.1–2.8mm, (\bar{X} =2.4mm, s.d.=0.28, n=7); ventrally 2.3–3.2mm, (\bar{X} =2.7mm, s.d.=0.27, n=8); gill length 2.2–3.0mm (\bar{X} =2.6mm, s.d.=0.23, n= 37).

Morphology as in *S. auripellitum* except for some minor differences, which may be variations that occur in both species. Gill shorter and with ventral primary branch bifurcating at about third length of gill (Fig. 132), but this bifurcation can occur at height of bifurcations of dorsal primary filaments. Head trichomes always bifid, tergite II with 3+3 simple hairs in line along postero-central region of segment and tergite V with or without patch of weak spine combs at antero-lateral margin.

DISTRIBUTION AND BIOLOGY. *Simulium incrustatum* was found in low numbers in smaller streams and rivers in the Minaçu area (Table 1, Fig. 148). It is a widespread species in mountainous areas throughout Brazil (Material examined) and is also found in Argentina, Colombia, Ecuador, Panama, Paraguay, Trinidad and Venezuela (Material examined; Coscarón 1987, 1991; Shelley *et al.*, 1997). It occurs in small streams attached to submerged vegetation and is anthropophilic in many areas, such as the Atlantic forest of Brazil and the onchocerciasis foci of Ecuador, southern Venezuela and Brazil (Coscarón, 1987, 1991; Ramírez Pérez, 1983; Shelley *et al.*, 1997).

Simulium (Psaroniocompsa) minusculum Lutz

(Figs. 17, 27, 44, 45, 54, 64, 74, 83, 92, 93, 104, 114, 123, 134, 147)

This common man-biting species was first described by Lutz from Minas Gerais state, Brazil. A more detailed description is given by Coscarón (1983).

FEMALE. General body colour black. Body length 1.5–2.2mm (\bar{X} =1.8mm, s.d.=1.58, n=25), wing length 1.1–1.6mm (\bar{X} =1.4mm, s.d.=0.10, n=25), wing width 0.5–0.8mm (\bar{X} =0.6mm, s.d.=0.08, n=25).

Head – dichoptic with red eyes; nudiocular triangle absent (Fig. 17). Rest of head black with silver pruinosity. Cibarium armed with 1+1 groups of large sharp teeth in several irregular rows in the area between the sclerotised central channel of the cibarium and the base of the well-developed, sclerotised, lateral arms or cornuae (Fig. 27).

Thorax – scutum black with silver pruinosity and numerous, recumbent, slender, gold hairs. Scutal pattern variable in relation to illumination. With anterior lighting black areas of scutum on silver pruinose background as follows: wide median black vitta extending from anterior border for almost four fifths of scutum, rounded and twice as wide posteriorly as on anterior scutal border; 1+1 disc-shaped vittae between median vitta and lateral margin of scutum, beginning in second quarter of scutum and extending to same posterior limit as median vitta; 1+1 intervittal triangular marks on anterior scutal border in pruinose area between median and disc-shaped vittae – tails extending for half length of scutum may be seen by tilting specimen slightly; humeri silver pruinose (Fig. 44). With posterior lighting median black vitta remains the same while the disc-shaped vittae extend to anterior margin of scutum to form bands of the same length and that run almost parallel to median vitta; intervittal triangular marks become silver pruinose; humeri black (Fig. 45). Subcostal wing vein bare. Basal sector of Radius with no hairs or spines. Legs mainly dark with pale bands (Fig. 54). Coxae, trochanters and femora brown; fore-leg tibia light brown, tarsus dark brown; mid leg tibia light brown, tarsus cream; hind leg tibia cream on basal half brown on distal half, basitarsus cream with distal fourth brown, second tarsal segment with basal half cream and distal half brown, rest of tarsi brown. Fore tarsi narrow as in *S. exiguum*. All femora and tibiae with scales as in Fig. 4. Claws without basal tooth.

Abdomen. Abdominal tergites black with segments I–V velvet and VI–IX shiny. Sternites dark brown, genitalia black. Eighth sternite strongly sclerotised with several stout setae laterally; gonopophyses well developed, membranous with slight sclerotisation on inner margin and covered in minute setae (Fig. 64).

Cerci hemispherical, paraprocts small and rounded (Fig. 74). Genital fork (Fig. 83) with sclerotised stem, well developed lateral arms and fine anterior processes. Spermatheca, oval, sclerotised with groups of internal spicules as in Fig. 7; area of insertion of spermathecal duct about one fourth maximum width of spermatheca as in Fig. 5.

MALE. General body colour black. Body length 1.4–1.9mm (\bar{X} =1.7mm, s.d.=0.16, n=6), wing length 1.4mm (\bar{X} =1.4mm, s.d.=0.02, n=4), wing width 0.5–0.9mm (\bar{X} =0.7mm, s.d.=0.19, n=4).

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

Thorax – Scutum velvet black with 1+1 submedian thin silver lines arising from anterior scutal border and extending for two thirds scutal length (Fig. 92), occasionally silver lines reduced to small bands on anterior scutal border (Fig. 93). Lateral and posterior margins of scutum silver pruinose, more easily seen when specimen tilted. Wing setation as in female. Leg coloration as in female (Fig. 54) except outer surface of tibia of front leg white.

Abdomen – Tergites velvet black with lateral silver patches on tergites II, III, VI–VIII, tergite IX shiny black. Genitalia black. Gonocoxite rectangular, slightly wider than long, gonocoxite small, subconical with sub-apical spine (Fig. 104). Ventral plate crescent-shaped with numerous hairs, longer in region of keel, and well developed, sclerotised basal arms (Fig. 114). Median sclerite oval with small apical incision (Fig. 114). Paramere lightly sclerotised with several long apical teeth (Fig. 123).

PUPA. Cocoon length dorsally 1.4–1.9mm (\bar{X} =1.7mm, s.d.=0.13, n=12), ventrally 1.6–2.0mm (\bar{X} =1.8mm, s.d.=0.16, n=12), pupa length 1.3–1.7mm (\bar{X} =1.6mm, s.d.=0.14, n=6), gill length 1.1–1.3mm (\bar{X} =1.2mm, s.d.=0.05, n=4).

Cocoon slipper shaped as in Fig. 9, mid brown, composed of fine fibres, with reinforced rim to anterior aperture, with central protuberance. Gill light brown with six forwardly-directed, slender filaments arranged in vertical plane (Fig. 134). Main trunk giving rise to three primary branches, ventral which bifurcates in basal fifth of gill, median (sometimes branching from base of dorsal primary branch) with bifurcation in basal third of gill and dorsal with bifurcation in basal tenth of gill. Tubercles usually absent on frontoclypeus and few present on cephalothorax (Fig. 147).

DISTRIBUTION AND BIOLOGY. *Simulium minusculum* occurred in medium sized rivers in the Minaçu area but was more common in the larger rivers (Table 1, Fig. 148). It is a common species in Brazil from south of the river Amazon into parts of Argentina and possibly Paraguay (Material Examined; Coscarón, 1983, 1987, 1991). Coscarón's references to the presence of *S.*

minusculum in Guyana, Colombia and Venezuela (1983, 1987, 1991) were presumably based on tentative identifications made in Shelley, Pinger & Moraes (1982) before reared topotypes had been examined. Further work (Py-Daniel, 1983; Shelley, Luna Dias & Maia Herzog, 1984; Shelley *et al.*, 1987) clarified the status of the closely similar species *S. minusculum*, *S. oyapockense* and *S. roraimense*. The specimens from Colombia, Guyana and Venezuela are now placed by us as *S. oyapockense* s.l. until this taxon is further split into its constituent species. *Simulium minusculum* is a highly anthropophilic species that breeds in rivers of various sizes but is only found in large numbers attached to submerged vegetation (particular species of Podostemaceae) in large, open rivers.

Simulium (Psilopelmia) lutzianum Pinto

(Figs. 18, 28, 46, 55, 65, 75, 94, 105, 115, 124, 135, 140)

This widely distributed species in South America has been fully described from Ecuador (Shelley, Arzube & Couch, 1989 as *lewisi*) and the Amazonia onchocerciasis focus of Brazil (Shelley *et al.*, 1997). The latter paper provides a detailed taxonomic discussion and new synonymies.

FEMALE. General body colour orange and black. Dimensions from pinned specimens. Body length 1.6–1.7mm (\bar{X} =1.7mm, s.d.=0.06, n=3); wing length 1.9–2.0mm (\bar{X} =2.0mm, s.d.=0.07, n=6), wing width 0.9–1.0mm (\bar{X} =0.9mm, s.d.=0.07, n=6).

Head – dichoptic with dark red eyes; nudiocular area present (Fig. 18). Rest of head black with silver pruinosity, mouthparts brown, antennae dark brown with scape and pedicel and first flagellomere orange. Cibarium with five irregular rows of blunt tubercles in area of central trough and a group of about 20–30 minute teeth between this and each cornua; anterior margin of cibarium sclerotised (Fig. 28).

Thorax – scutum orange with lateral margins white pruinose, with numerous adpressed dark brown hairs lying singly (Fig. 46). Scutellum orange, postnotum dark brown with faint silver pruinosity. Subcostal wing vein with four setae [For variation in this character see Shelley, Arzube & Couch, (1989)]; basal section of Radius with single row of setae. Legs brownish black except basal two-thirds of mid and hind basitarsi, which are white (Fig. 55). Proportions of legs as in Fig. 55, claws curved, each with a small tooth as in Fig. 3.

Abdomen – tergites I–III bright yellow, sometimes orange, tergite IV velvet-black, tergites VI–IX shiny black or mottled brown and black. Occasionally specimens occur in which tergites I–IV are yellow, in which case tergite V is velvet-black. Sternites I–III yellowish brown, rest mid brown, genitalia dark brown. Eighth sternite well sclerotised, gonopophyses small, mem-

branous with minute hairs (Fig. 65). Paraprocts broadly rectangular with pronounced ventral extension (Fig. 75). Genital fork slender with sclerotised, triangular, anteriorly-directed processes (Fig. 84). Spermatheca oval, sclerotised, with no external sculpturing, area of insertion of spermathecal duct membranous, one-third as wide as maximum width of spermatheca as in Fig. 5.

MALE. General body colour orange and black. Dimensions are from Shelley, Arzube & Couch (1989, as *lewisi*) due to lack of material from Minaçu. Body length 1.7–3.1 mm (\bar{X} =2.2 mm, s.d.=0.35, n=16), wing length 1.7–2.0 mm (\bar{X} =1.8 mm, s.d.=0.1, n=14), wing width 0.7–0.9 mm (\bar{X} =0.9, s.d.=0.06, n=16).

Head – holoptic with dark red eyes. Coloration of rest of head as in female.

Thorax – coloration and hairing of thorax and its appendages as in female (Figs. 46, 55, 94) except subcostal vein of wing devoid of setae.

Abdomen – tergites I–III yellow, rest of tergites and genitalia velvet-black. Silver ornamentation as follows: tergite II faintly silver pruinose and tergites VI, VII and IX with obvious silver patches laterally. Sternites I–III orange, IV–IX dark brown. Gonocoxite longer than wide, gonostyle longer than wide and about half length of gonocoxite and with distal spine (Fig. 105). Ventral plate membranous with sclerotised, reduced basal arms, a small keel and hairs covering most of its surface (Fig. 115). Median sclerite pyriform with small apical incision (Fig. 115). Paramere as in Fig. 124 with few distal spines of varying sizes.

PUPA. Cocoon length dorsally 2.2–2.4 mm (\bar{X} =2.3 mm, s.d.=0.1, n=3), ventrally 2.4–2.6 mm (\bar{X} =2.5 mm, s.d.=0.12, n=3); pupa length 2.2 mm (n=1); gill length 1.0–2.5 mm (\bar{X} =2.0 mm, s.d.=0.35, n=21).

Cocoon slipper-shaped as in Fig. 9, white under natural conditions and light brown in alcohol; rim of aperture thickened and without median protuberance, median thickened dorsal ridge often present connecting with rim of aperture. Cocoon very thick, composed of amorphous, elastic substance containing fibres (Fig. 140). Gill light brown with eight, closely grouped, forwardly-directed, slender filaments arranged in a vertical plane (Fig. 135). Main trunk giving rise to three primary branches in basal third of gill, ventral with two filaments and median and dorsal each with three filaments. All primary branches bifurcate in basal fifth of gill; dorsal filaments of median and dorsal primary branches further bifurcate in basal 2/5ths gill.

DISTRIBUTION AND BIOLOGY. This was an uncommon species occurring in only three rivers locally (Table 1, Fig. 148). Elsewhere in Brazil it has been recorded in the Amazonia onchocerciasis focus at one locality (Shelley *et al.*, 1997) and in Paraná and Santa Catarina states in the south (Material Examined; Dellome Filho, 1991). *Simulium lutzianum* has a wide-

spread distribution in Latin America ranging from Panama to Argentina (Coscarón, 1991; Ramírez Pérez, 1983 [as *lewisi* and *lutzianum*]; Shelley, Arzube & Couch, 1989). It breeds in both small streams and larger rivers and is recorded as zoophilic except in Paraná State, Brazil (Dellome Filho, 1991).

Simulium (Trichodagmia) guianense Wise complex

(Figs. 10, 19, 29, 47, 56, 66, 76, 85, 95, 96, 106, 116)

The description of this species, common in Brazil, is based on material from Minaçu. More detail on morphological variations can be found in Shelley *et al.* (1997).

FEMALE. General body colour black. Body length 2.0–2.4 mm (\bar{X} = 2.2 mm, s.d. = 0.31, n = 2); wing length 2.0–2.5 mm (\bar{X} = 2.3 mm, s.d. = 0.2, n = 4), wing width 0.9–1.2 mm (\bar{X} = 1.0, s.d. = 0.1, n = 4).

Head – dichoptic with dark red eyes; nudiocular area present (Fig. 19). Rest of head black with grey pruinosity. Cibarium unarmed with well developed, sclerotised cornuae (Fig. 29).

Thorax – grey with faint silvery grey pruinosity. Scutum and scutellum with numerous, short, broad, brass-coloured fine or widened setae arranged irregularly in small groups (Fig. 47); in freshly emerged specimens fine median line without scales runs two thirds length of scutum from anterior border. Wing with Subcostal vein bare (but can have up to six fine setae in distal half in other regions of Brazil (Shelley *et al.*, 1997). Basal sector of Radius with or without single row of hairlike setae on basal two thirds, single row of spine-like setae interspersed with hairlike setae on distal third. Legs brown and white banded as follows: fore leg with coxa, trochanter and femur light brown, tibia light brown with anterior surface white and upper border dark brown, and tarsus black; mid leg coxa dark grey pruinose, trochanter and femur light brown, tibia grey, basitarsus white with black distal articulation and rest of tarsus black; hind leg coxa dark grey pruinose, trochanter light brown, femur black, tibia black with basal articulation and outer distal half of margin white, basitarsus with basal three quarters white and distal quarter black, rest of tarsus black (Fig. 56). Proportions of legs as in Fig. 56, showing expanded fore tarsi. Scale-like hairs on femora and tibiae of mid and hind legs as in *S. incrustatum* (Fig. 4). Claws curved and slender without basal tooth.

Abdomen – Tergites I–IV velvet black with silver pruinosity covering tergite II, tergites V–IX shiny black. Genitalia black. Eighth sternite highly sclerotised in posterior two thirds with well developed setae, gonopophyses large, rounded and membranous, densely covered in fine setae (Fig. 66). Cerci hemispherical; paraprocts broadly quadrangular with

dorsally exposed part sclerotised and more ventral part membranous with small tail-like projection pointing internally close to gonopophyses, whole paraproct densely covered in setae (Fig. 76). Genital fork (Fig. 85) short, with highly developed lateral arms and sclerotised, fine anterior processes. Spermatheca oval, highly sclerotised, with internal sculpturing and few small internal spicules; width of membranous area of insertion of spermathecal duct large, about half maximum width of spermatheca as in Fig. 5.

MALE. General body colour black. Body length 2.6–2.7 mm (\bar{X} = 2.6 mm, s.d. = 0.0.11, n = 2); wing length 2.0–2.2 mm (\bar{X} = 2.1, s.d. = 0.08, n = 3); wing width 1.0 mm (\bar{X} = 1.0 mm, s.d. = 0.03, n = 3).

Head – holoptic with dark red eyes. Rest of head black with silvery grey pruinosity and many, long, dark, upright setae.

Thorax – velvet black with silvery grey pruinosity varying with light direction. With anterior light source large black anchor-shaped pattern covering most of scutum (Fig. 95). With posterior light source pruinosity more extensive and pattern consisting of a median velvet black band in the form of a capital T with the transverse stroke occupying the anterior border of the scutum and 1+1 lateral short velvet black bands occupying the median third of the scutum (Fig. 96).

Wing venation as in female except basal sector of Radius and Subcostal veins bare. Leg coloration as in female except light brown and grey areas black in fully coloured specimens.

Abdomen – Abdominal tergites velvet black with silver ornamentation as follows: tergite II all silver except for posterior edge and median area of posterior half of segment, most of lateral area of tergites V, VI & VII and lower margin of tergite VIII. Genitalia dark brown. Gonocoxite subrectangular; gonostyle elongate, pyriform with large blunt distal spine (Fig. 106). Ventral plate sclerotised, rectangular with shallow, apical (posterior) depression, well developed basal (anterior) arms and setose ventral bulbous prolongation (Fig. 116). Median sclerite rectangular with deep incision at narrower apex (Fig. 116). Paramere poorly developed with no spines and little sclerotisation (Fig. 125).

PUPA. Cocoon length dorsally 2.2–2.9 mm (\bar{X} = 2.6 mm, s.d. = 0.26, n = 4); ventrally 2.2–3.4 mm (\bar{X} = 2.8 mm, s.d. = 0.55, n = 5); pupa length 2.1–2.3 mm (\bar{X} = 2.2 mm, s.d. = 0.09, n = 3); gill length 0.5–0.6 mm (\bar{X} = 0.5 mm, s.d. = 0.03, n = 3).

Cocoon shoe-shaped (Fig. 10), light to dark brown; rim of aperture not reinforced and without central protuberance. Cocoon of smooth and gelatinous appearance with no obvious fibres (as in Fig. 140). Gill light brown with twelve filaments arranged in form of antlers (Fig. 136), main trunk giving rise to three primary branches, dorsal with six filaments, median

with four filaments and ventral with two filaments. Branching of filaments in basal two thirds of gill. Filaments short with distal ends dark and pointed, their more distal surfaces with spicules in annular arrangement.

DISTRIBUTION AND BIOLOGY. This species was found in rivers from 5 to over 50 metres wide (Table 1, Fig. 148). As in other parts of Brazil it is usually associated with plants of the family Podostemaceae that are attached to rocks in fast flowing, sunlit parts of rivers. In Minaçu *S. guianense* is often abundant in its breeding grounds but only bites man in small numbers at the end of the dry season. Elsewhere in Brazil the species is widespread from Paraná to Roraima states with both zoophilic and anthropophilic populations, and also occurs in the Guianas and Venezuela (See Shelley *et al.*, 1997 for details). The suggestion (*op. cit.*) that differences in biting behaviour indicates the presence of a species complex has now been confirmed: recent work by Charalambous *et al.* (1996) has shown the existence of four cytotypes in *S. guianense*.

Simulium (Trichodagmia) nigrimanum Macquart

(Figs. 2, 3, 20, 30, 48, 57, 67, 77, 86, 97, 107, 117, 126, 137)

An originally poorly known species described from São Paulo State, Brazil and still regarded as a *species inquirenda* by various authors. We accept the more fully described *S. pruinosum* Lutz as its junior synonym based on an examination of type specimens. For information on taxonomic status and more recent descriptions of this species the following authors should be consulted: Coscarón, 1987, 1991; Py-Daniel, 1989; Shelley *et al.*, 1984.

FEMALE. General body colour brown. Body length 3.3–4.1 mm (\bar{X} = 3.5 mm, s.d. = 0.21, n = 13), wing length 2.6–3.2 mm (\bar{X} = 2.9 mm, s.d. = 0.16, n = 17), wing width 1.1–1.5 mm (\bar{X} = 1.3 mm, s.d. = 0.1, n = 17).

Head – dichoptic with red eyes; nudiocular area present (Fig. 20). Rest of head black with grey pruinosity. Cibarium heavily sclerotised with single row of stout, blunt teeth in channel between cornuae (Fig. 30).

Thorax – scutum dark brown to brownish black with faint darker median line and no pattern; scutum with numerous, recumbent, brass-coloured hairs (Fig. 48). Subcostal wing vein with line of setae (but bare in specimens from Colombia), Radius with double row of hairs in basal half and spines interspersed with hairs in distal half (Fig. 2). Legs with dark and pale bands (Fig. 57). Coxa, trochanter and femur of fore leg light brown, tibia and tarsus brown to black; coxa, trochanter and femur of mid leg light brown, tibia brown to black with white basal articulation, tarsus brown to

black with basal two thirds of basitarsus white; coxa and trochanter of hind leg brown, femur dark brown, tibia brown to black with white basal articulation, tarsus brown to black with basal half of basitarsus and second tarsomeres white. Claws with well developed basal tooth (Fig. 3).

Abdomen— matt black with tergites VI–IX shiny black. Sternites black, genitalia brown. Eighth sternite with highly sclerotised posterior margins and 1+1 groups of up to six setae; gonopophyses well developed, membranous and covered in fine setae (Fig. 67). Cerci hemispherical, paraprocts well developed and quadrangular (Fig. 77). Genital fork (Fig. 86) slightly sclerotised with well developed lateral arms and anterior processes. Spermatheca oval, sclerotised with lines of fine, internal spicules as in Fig. 7; area of insertion of spermathecal duct about one fourth maximum width of spermatheca as in Fig. 5.

MALE. General body colour brown. Body length 2.9–3.8mm (\bar{X} =3.4mm, s.d.=0.37, n=4), wing length 2.3–3.1mm (\bar{X} =2.6mm, s.d.=0.34, n=4), wing width 1.1–1.4mm (\bar{X} =1.2mm, s.d.=0.14, n=4).

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

Thorax— dark brown with grey pruinosity, scutum with no pattern and numerous adpressed brass-coloured hairs (Fig. 97). Wing setation as in female except Subcosta with either no setae or one seta basally or in mid section of vein; Radius as in female except single line of fine setae in basal half. Leg coloration as in female (Fig. 57).

Abdomen— abdominal tergites black with silver pruinosity covering tergite II except for median area and lateral on tergites V–VIII, tergite IX shiny black. Genitalia dark brown. Gonocoxite almost square, gonostyle slender, pyriform almost 50% longer than gonocoxite and with five or six stout spines at distal tip (Fig. 107). Ventral plate with rounded, well developed keel with many long hairs, basal arms highly sclerotised and parallel (Fig. 117). Median sclerite pyriform with apical depression (Fig. 117). Paramere membranous, poorly developed, without apical teeth (Fig. 126).

PUPA. Cocoon length dorsally 2.5–3.3mm (\bar{X} =2.9mm, s.d.=0.23, n=13), ventrally 3.1–4.3mm (\bar{X} =3.7mm, s.d.=0.32, n=8), pupa length 2.8–5.1mm (\bar{X} =3.5mm, s.d.=0.68, n=9), gill length 1.3–1.7mm (\bar{X} =1.5mm, s.d.=0.22, n=3).

Cocoon shoe-shaped as in Fig. 10., light brown, gelatinous in appearance as in Fig. 140 and with a reinforced rim. Gill white consisting of a bunch of 18 short, upwardly directed filaments branching at various heights in basal half and with rounded ends (Fig. 137).

DISTRIBUTION AND BIOLOGY. *Simulium nigrimanum* was more frequently found in the Minaçu area in

smaller to medium size rivers but occasionally was found breeding in a larger river (Table 1, Fig. 148). In Brazil it occurs in the Federal District and states of Goiás, Mato Grosso, Minas Gerais, Paraná, São Paulo and Tocantins and has also been recorded from Argentina, Colombia, Paraguay and Venezuela (Material examined; Coscarón, 1991 [as *pruinsum*]). It breeds in small to medium fast flowing rivers on rocks and plant roots and twigs. In some places it may be zoophilic, but in many areas it will commonly bite man usually in early morning and late afternoon. *Simulium nigrimanum* has been suspected of causing *Pemphigus foliaceus*, an autoimmune skin blistering reaction, which is possibly in response to the saliva of this simuliid species where it bites man in the state of Mato Grosso do Sul in Brazil (Eaton *et al.*, 1998).

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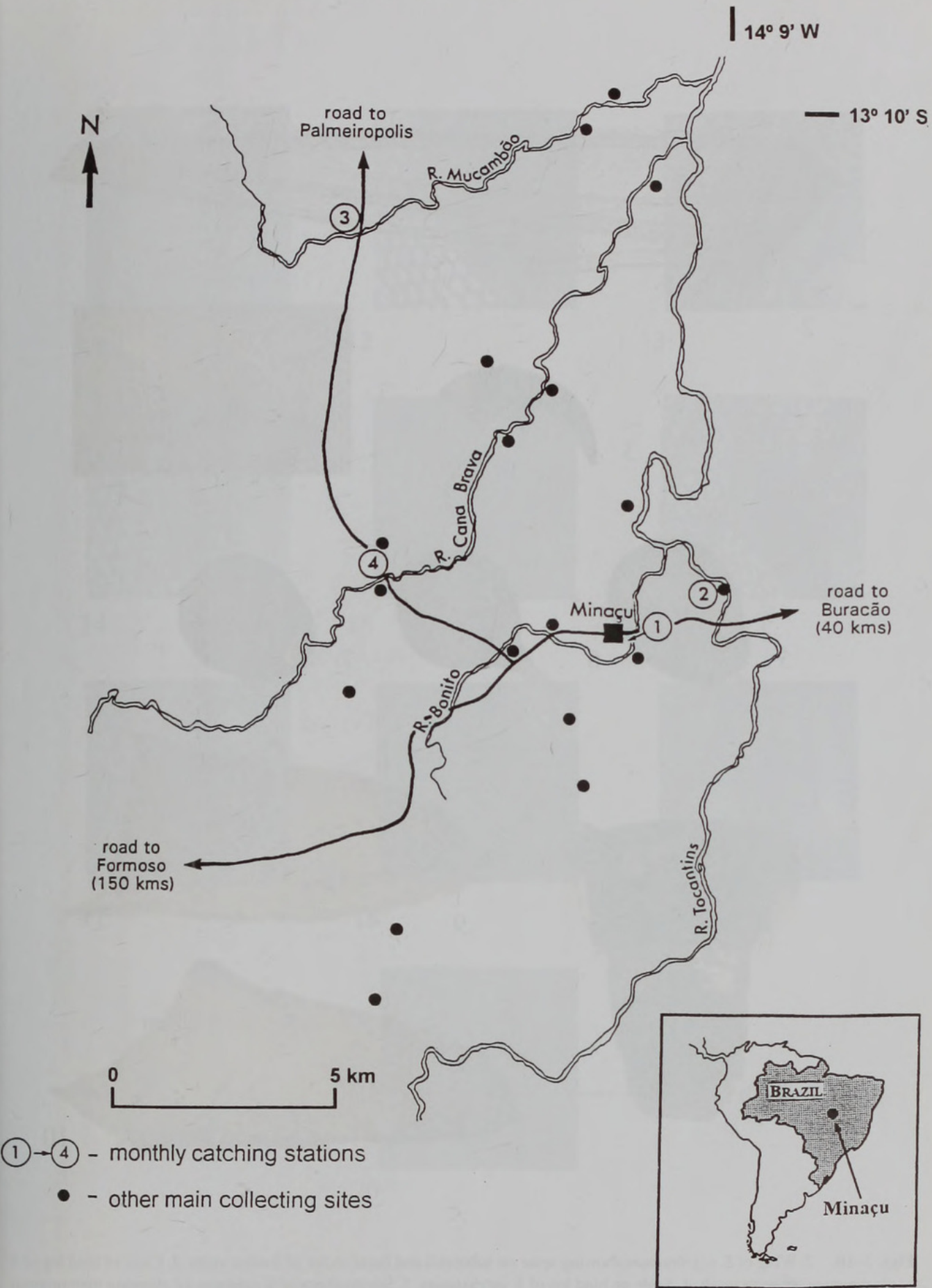
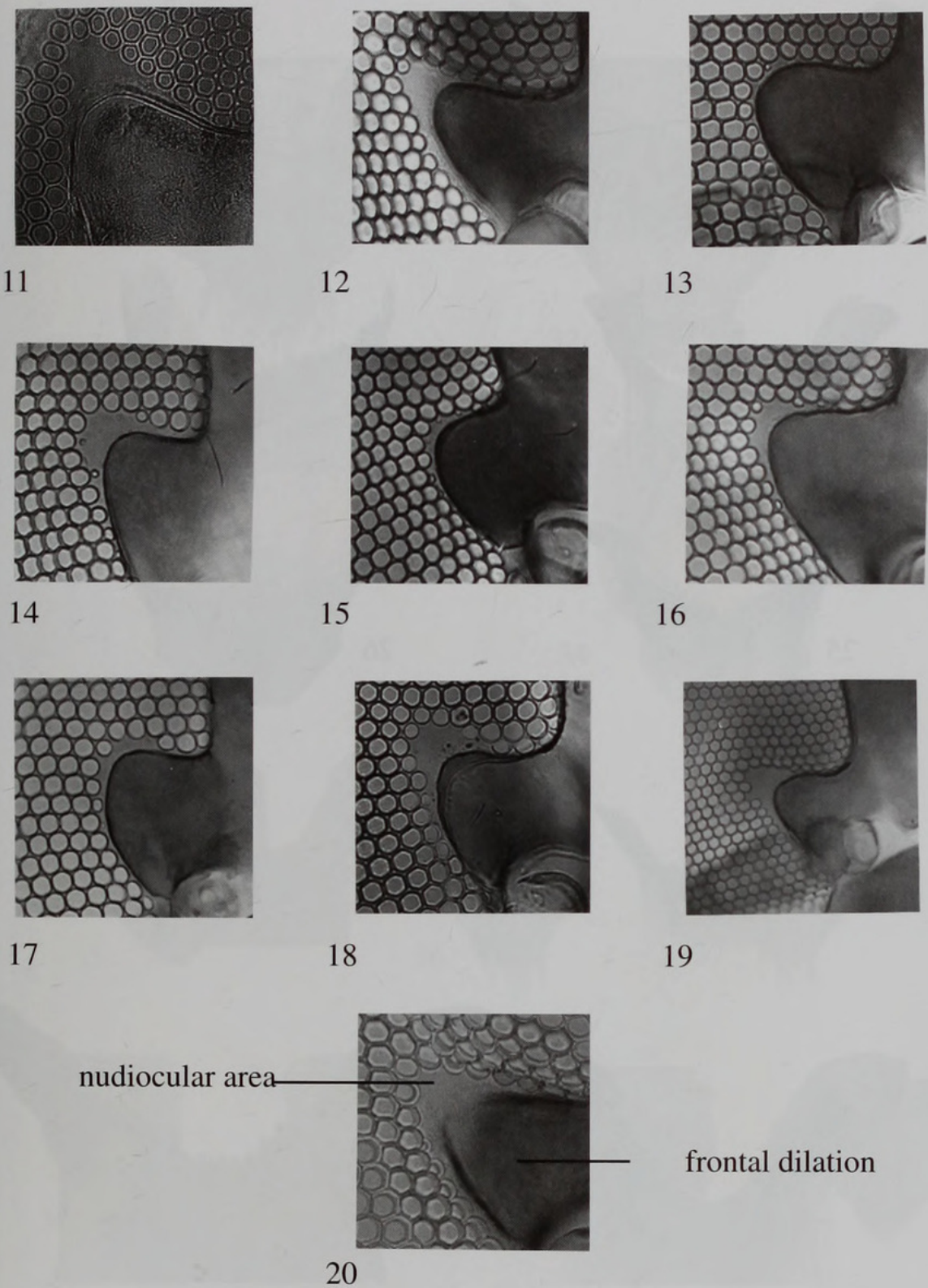


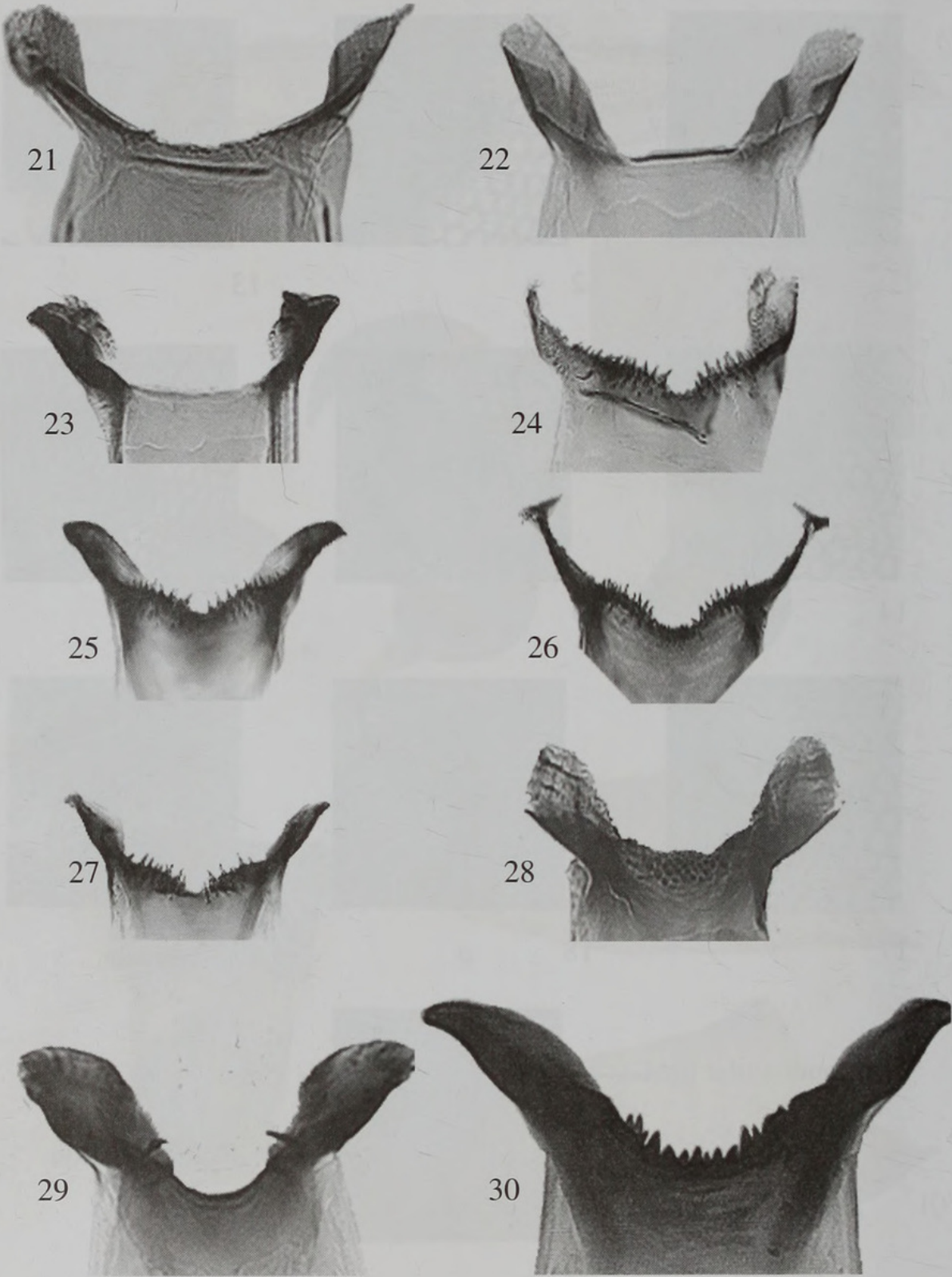
Fig. 1. Minaçu area showing collecting sites.



Figs. 2–10. 2. Wing of *S. nigrimanum* showing setae on subcostal and basal sector of Radius veins. 3. Claw of hind leg of *S. nigrimanum* showing tooth. 4. Scale on hind leg of *S. incrustatum*. 5. Spermatheca of *S. exiguum* s.l. showing membranous insertion of spermathecal duct. 6. Spermatheca of *S. cuasiexiguum* showing sclerotised area of insertion of spermathecal duct. 7. Spermatheca of *S. auripellitum* showing internal spicules. 8. Male abdomen of *S. exiguum* s.l. showing areas of pruinosity on tergites II, V–VII. 9. Slipper-shaped cocoon of *S. subpallidum*. 10. Shoe-shaped cocoon of *S. guianense* s.l.



Figs.11–20. Nudiocular areas of: 11. *S. spinibranchium*; 12. *S. subpallidum*; 13. *S. exiguum* s.l.; 14. *S. auripellitum*; 15. *S. auripellitum* (anchor pattern); 16. *S. incrustatum*; 17. *S. minusculum*; 18. *S. lutzianum*; 19. *S. guianense* s.l.; 20. *S. nigrimanum*.



Figs: 21–30. Cibariums of: 21. *S. spinibranchium*; 22. *S. subpallidum*; 23. *S. exiguum* s.l.; 24. *S. auripellitum*; 25. *S. auripellitum* (anchor pattern); 26. *S. incrustatum*; 27. *S. minusculum*; 28. *S. lutzianum*; 29. *S. guianense* s.l.; 30. *S. nigrimanum*.

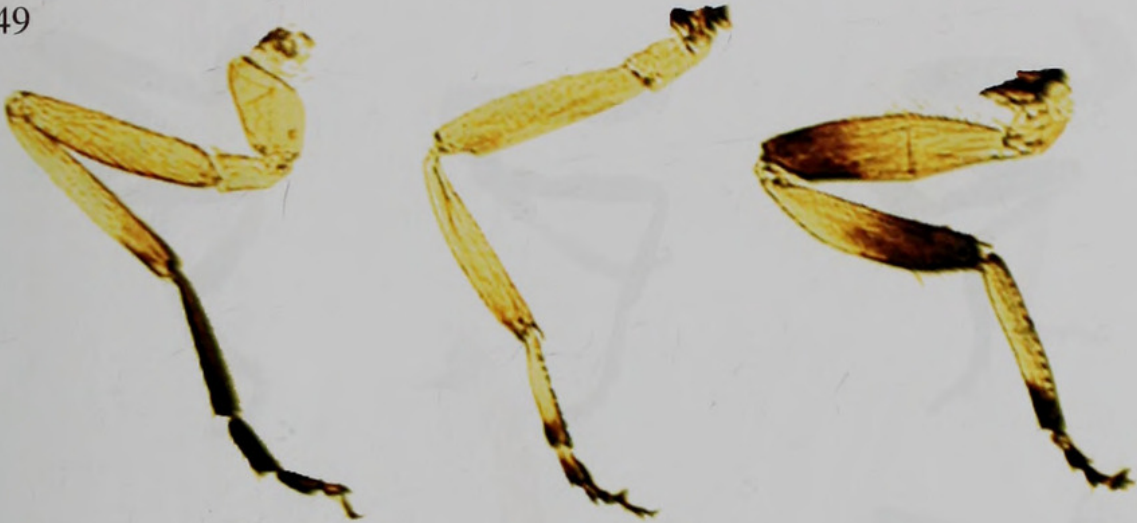


Figs. 31–41. Scutal patterns of female: 31. *S. spinibranchium* (light source anterior); 32. *S. spinibranchium* (light source posterior); 33. *S. subpallidum* (light source anterior); 34. *S. subpallidum* (light source posterior); 35. *S. exiguum* s.l.; 36. *S. auripellitum* holotype (light source anterior); 37. *S. auripellitum* holotype (light source posterior); 38. *S. auripellitum* (light source anterior); 39. *S. auripellitum* (light source posterior); 40. *S. auripellitum* (anchor pattern) (light source anterior); 41. *S. auripellitum* (anchor pattern) (light source posterior).



Figs. 42–48. Scutal patterns of female: 42. *S. incrustatum* (light source anterior); 43. *S. incrustatum* (light source posterior); 44. *S. minusculum* (light source anterior); 45. *S. minusculum* (light source posterior); 46. *S. lutzianum*; 47. *S. guianense* s.l.; 48. *S. nigrimanum*.

49



50



51



Figs. 49–51. Colour patterns and proportions of fore, mid and hind legs of female: 49. *S. spinibranchium*; 50. *S. subpallidum*; 51. *S. exiguum s.l.*.

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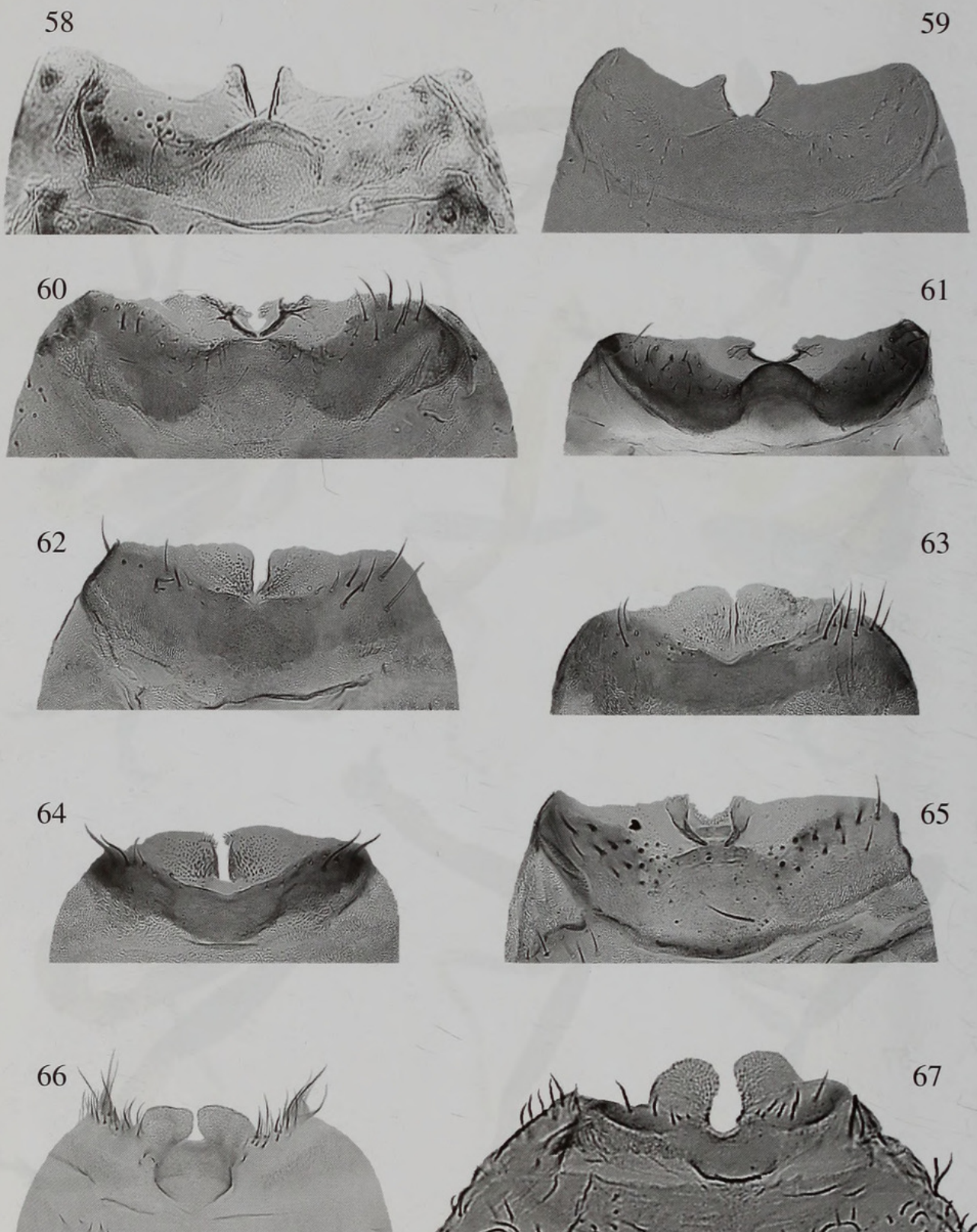
54



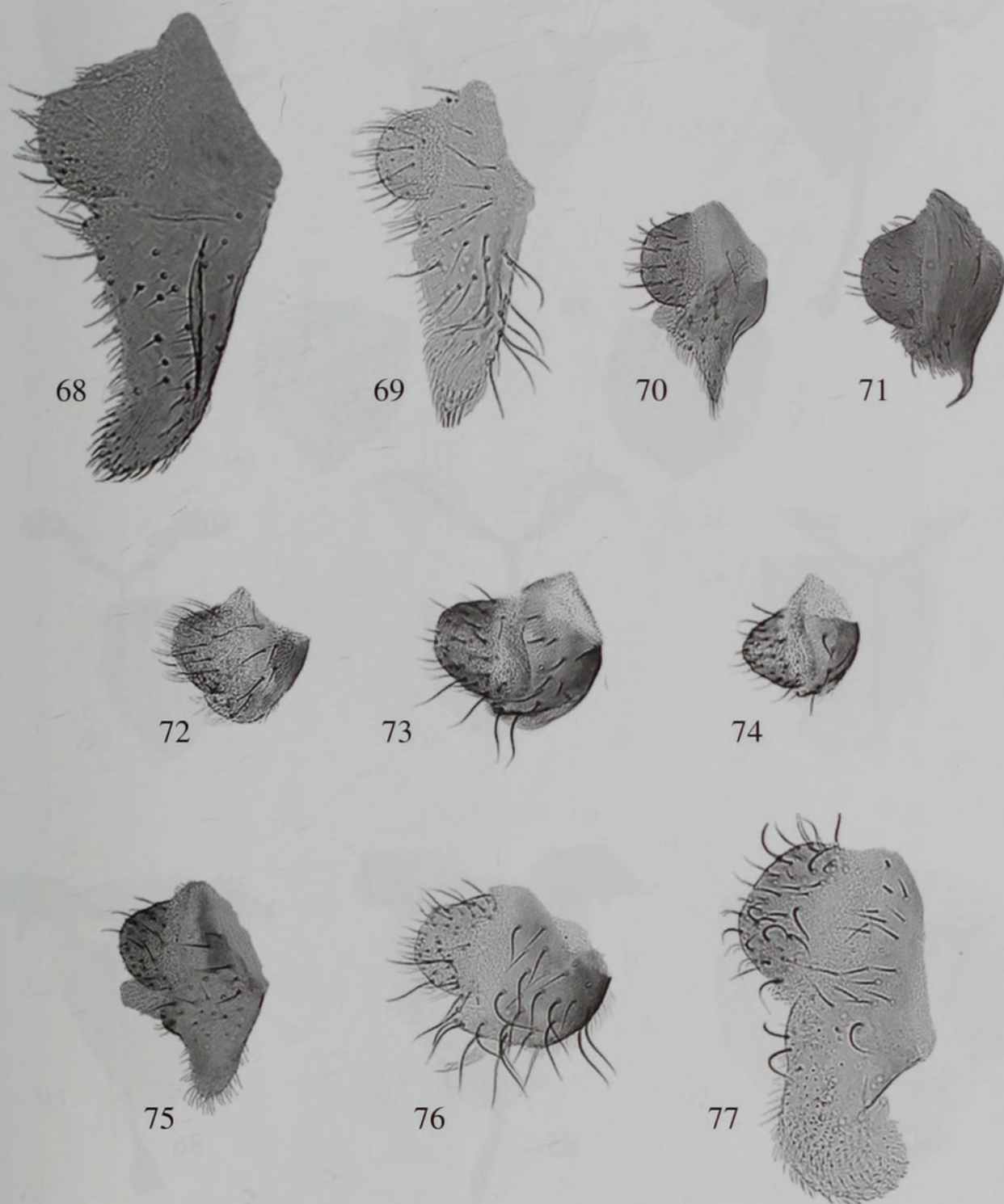
Figs. 52–54. Colour patterns and proportions of fore, mid and hind legs of female: 52. *S. aripellitum*; 53. *S. incrustatum*; 54. *S. minusculum*.



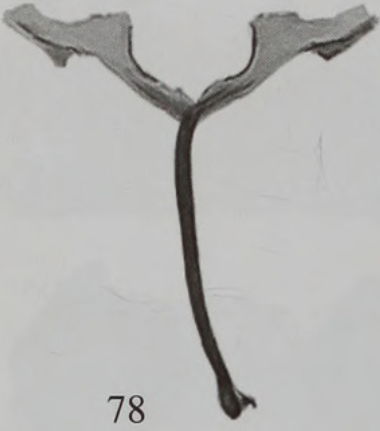
Figs. 55–57. Colour patterns and proportions of fore, mid and hind legs of female: 55. *S. lutzianum*; 56. *S. guianense s.l.*; 57. *S. nigrimanum*.



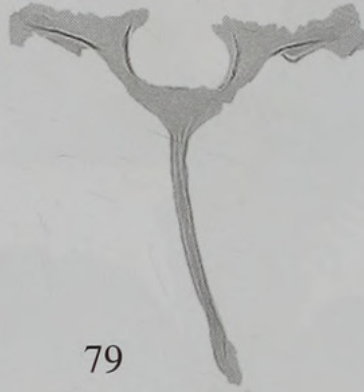
Figs. 58–67. Eighth sternite and gonopophyses of: 58. *S. spinibranchium*; 59. *S. subpallidum*; 60. *S. exiguum* s.l.; 61. *S. cuasiexiguum*; 62. *S. auripellitum*; 63. *S. incrustatum*; 64. *S. minusculum*; 65. *S. lutzianum*; 66. *S. guianense* s.l.; 67. *S. nigrimanum*.



Figs.68–77. Paraproct of: 68. *S. spinibranchium*; 69. *S. subpallidum*; 70. *S. exiguum* s.l.; 71. *S. cuasiexiguum*; 72. *S. auripellitum*; 73. *S. incrustatum*; 74. *S. minusculum*; 75. *S. lutzianum*; 76. *S. guianense* s.l.; 77. *S. nigrimanum*.



78



79



80



81



82



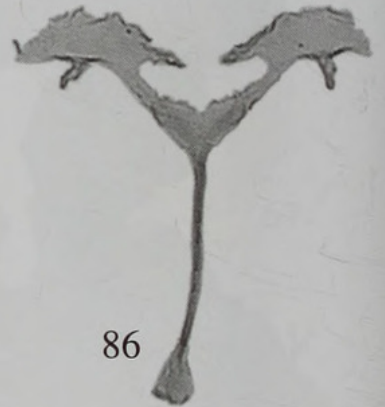
83



84



85

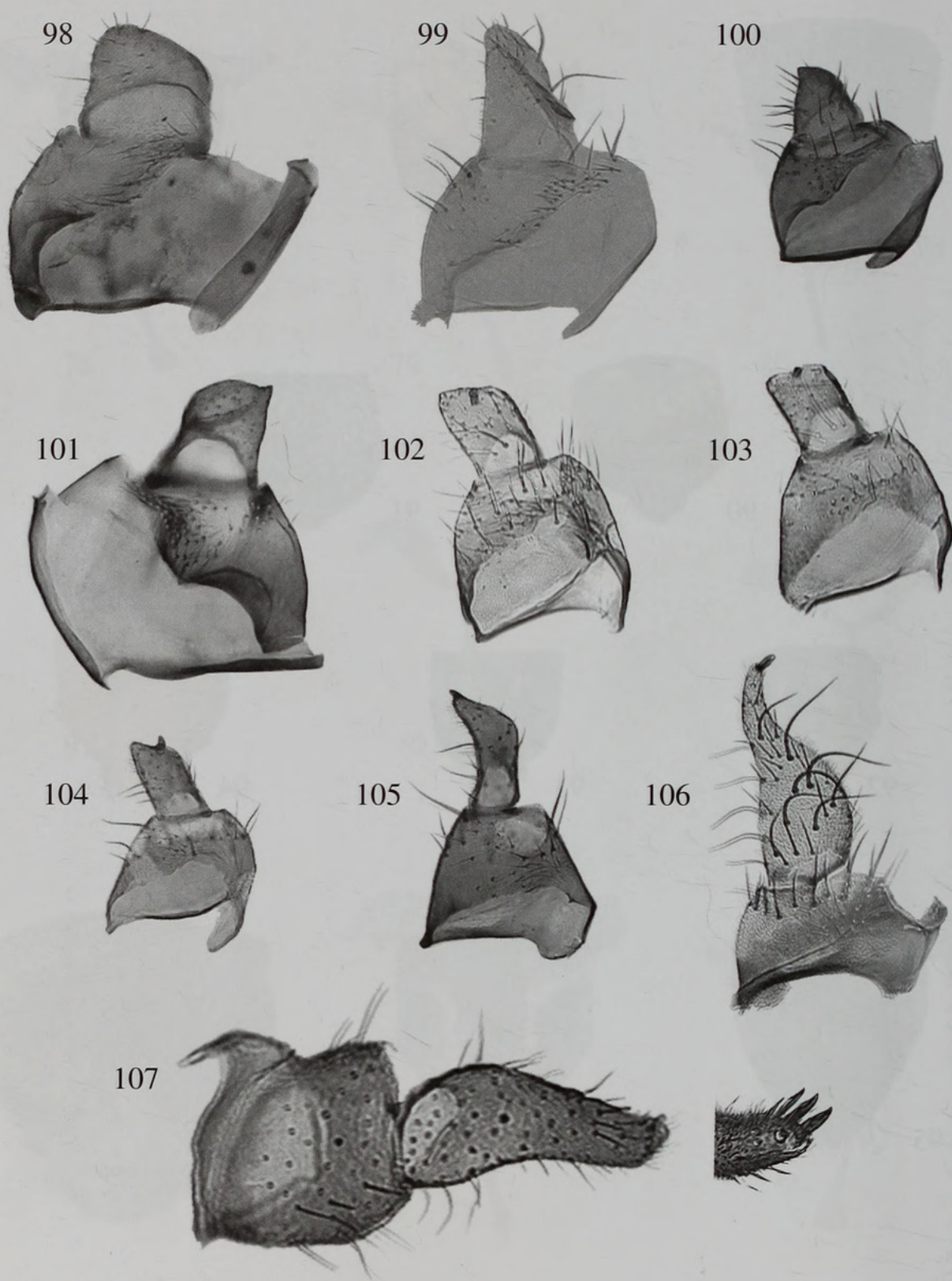


86

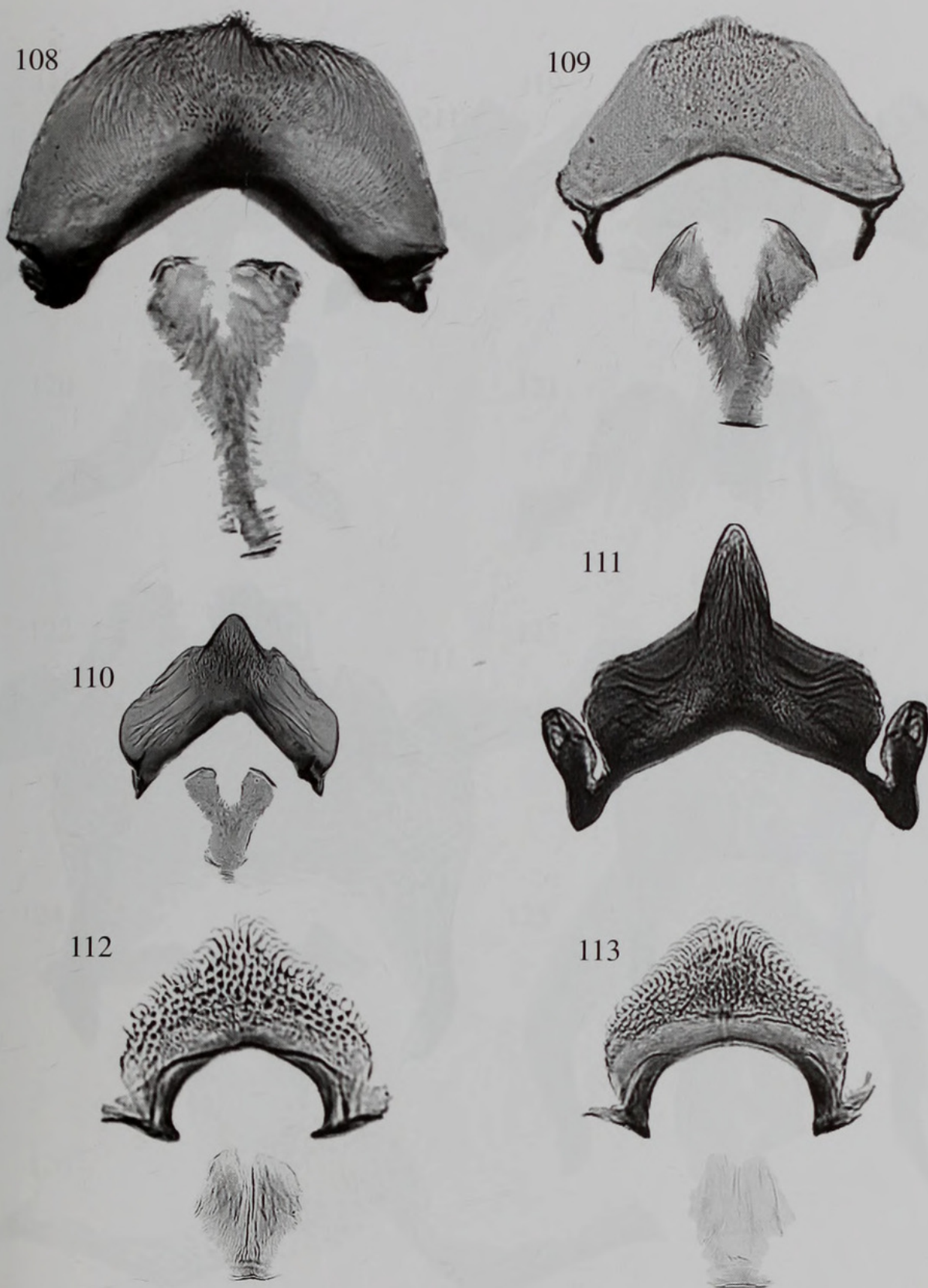
Figs. 78–86. Genital fork of: 78. *S. spinibranchium*; 79. *S. subpallidum*; 80. *S. exiguum* s.l.; 81. *S. auripellitum*; 82. *S. incrustatum*; 83. *S. minusculum*; 84. *S. lutzianum*; 85. *S. guianense* s.l.; 86. *S. nigrimanum*.



Figs. 87–97. Scutal patterns of male: 87. *S. spinibranchium*; 88. *S. subpallidum*; 89. *S. exiguum* s.l.; 90. *S. auripellitum*; 91. *S. incrustatum*; 92. *S. minusculum*; 93. *S. minusculum* (with reduced submedian bands); 94. *S. lutzianum*; 95. *S. guianense* s.l. (light source anterior); 96. *S. guianense* s.l. (light source posterior); 97. *S. nigrimanum*.



Figs. 98–107. Gonocoxite and gonostyle of: 98. *S. spinibranchium*; 99. *S. subpallidum*; 100. *S. exiguum* s.l.; 101. *S. cuasiexiguum*; 102. *S. auripellitum*; 103. *S. incrustatum*; 104. *S. minusculum*; 105. *S. lutzianum*; 106. *S. guianense* s.l.; 107. *S. nigrimanum* (with distal part of gonostyle magnified to show spines).



Figs. 108–113. Ventral plate (ventral view) and median sclerite of: 108. *S. spinibranchium*; 109. *S. subpallidum*; 110. *S. exiguum* s.l.; 111. *S. cuasiexiguum*; 112. *S. auripellitum*; 113. *S. incrustatum*.

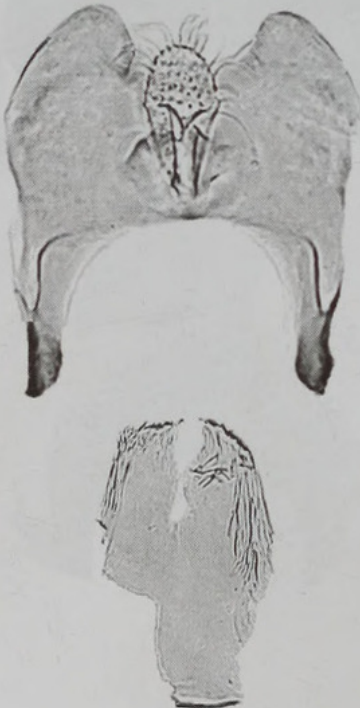
114



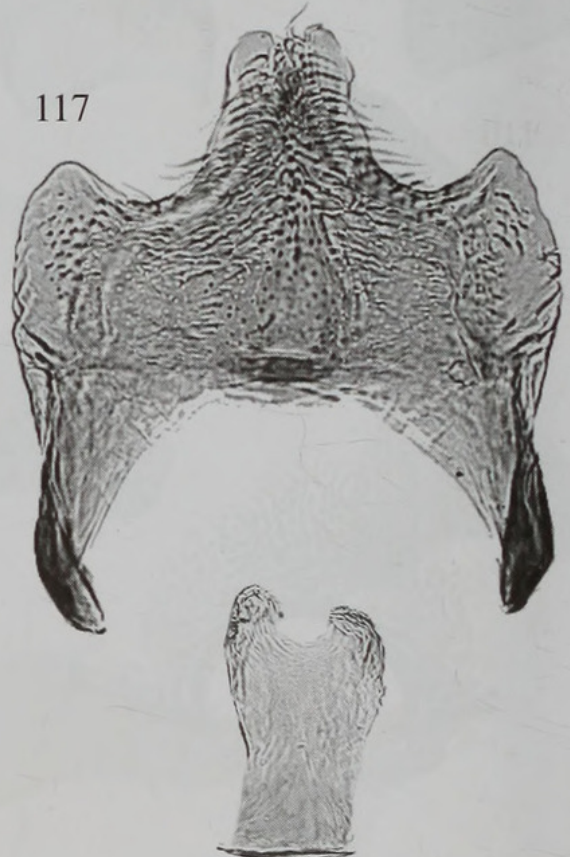
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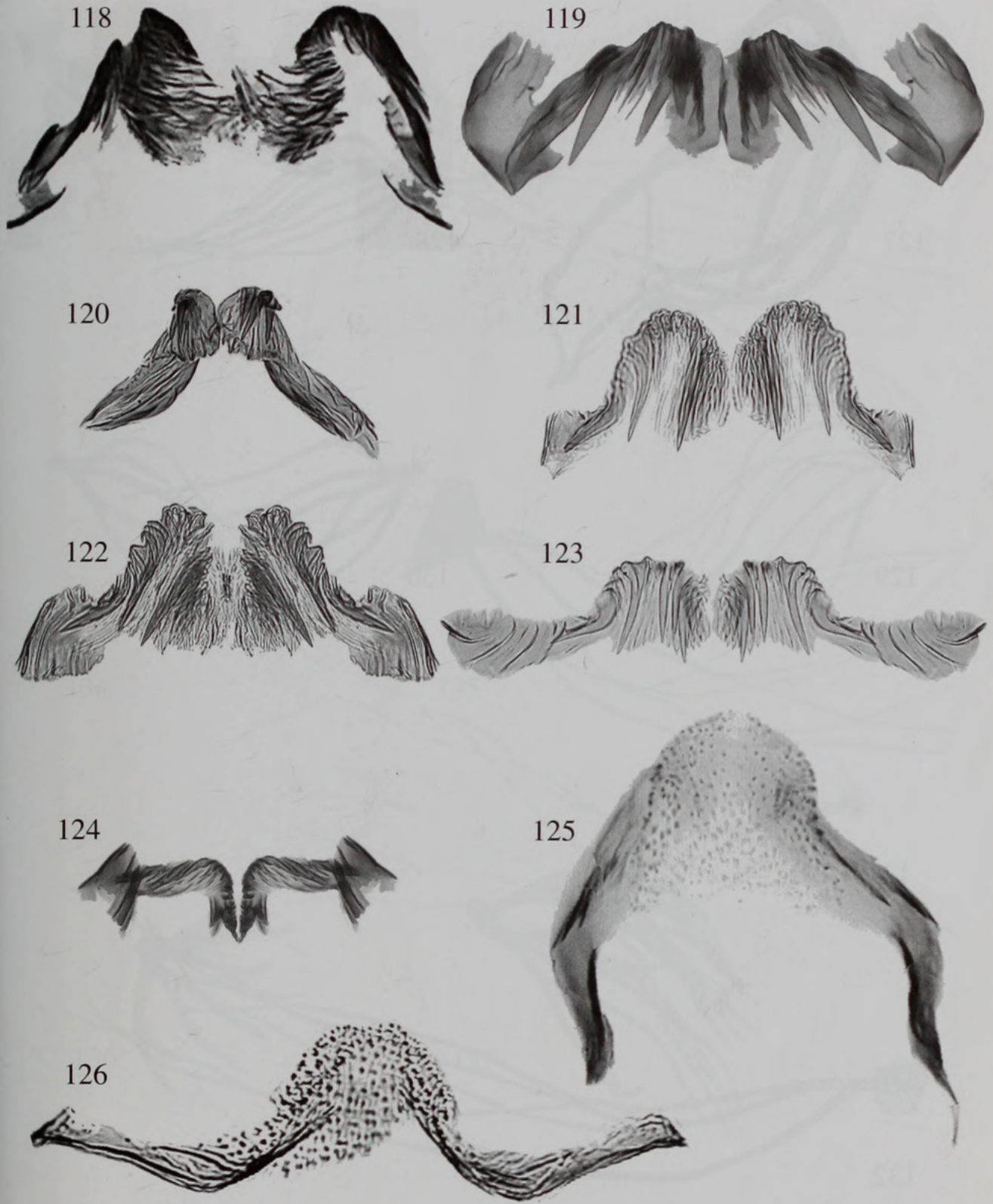
116



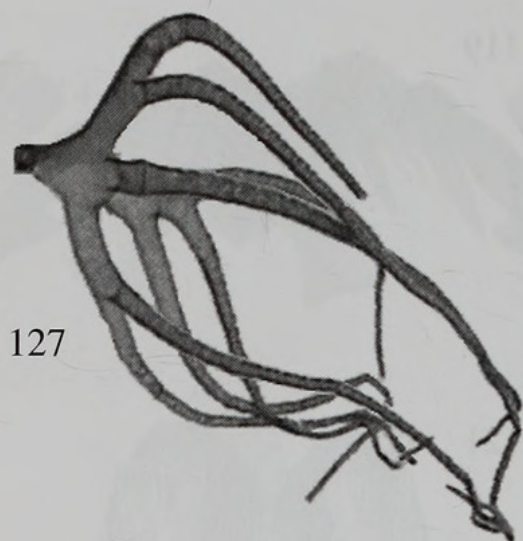
117



Figs. 114–117. Ventral plate (ventral view) and median sclerite of : 114. *S. minusculum*; 115. *S. lutzianum*; 116. *S. guianense* s.l.; 117. *S. nigrimanum*.



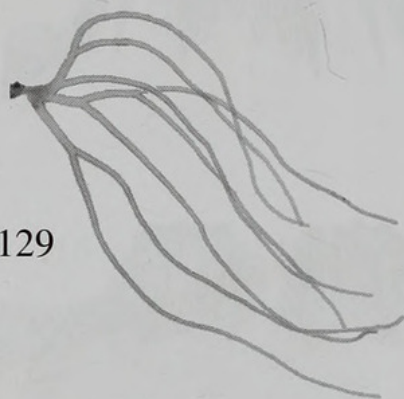
Figs. 118–126. Paramere of: 118. *S. spinibranchium*; 119. *S. subpallidum*; 120. *S. exiguum* s.l.; 121. *S. auripellitum*; 122. *S. incrustatum*; 123. *S. minusculum*; 124. *S. lutzianum*; 125. *S. guianense* s.l.; 126. *S. nigrimanum*.



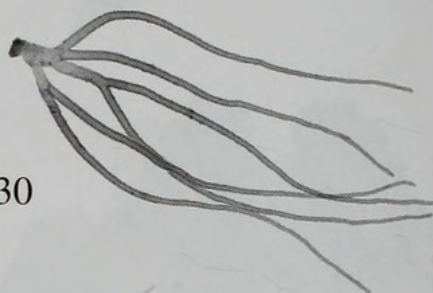
127



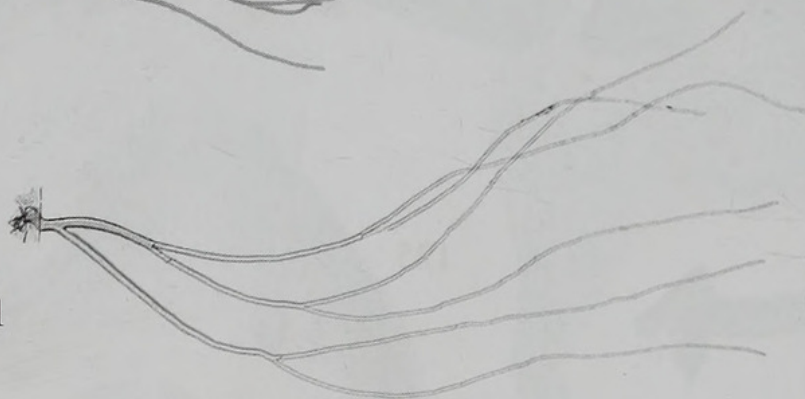
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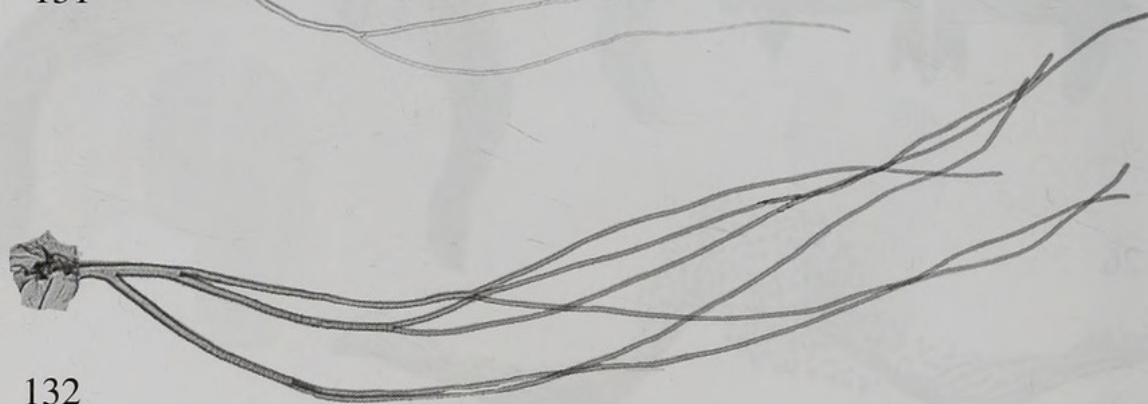
129



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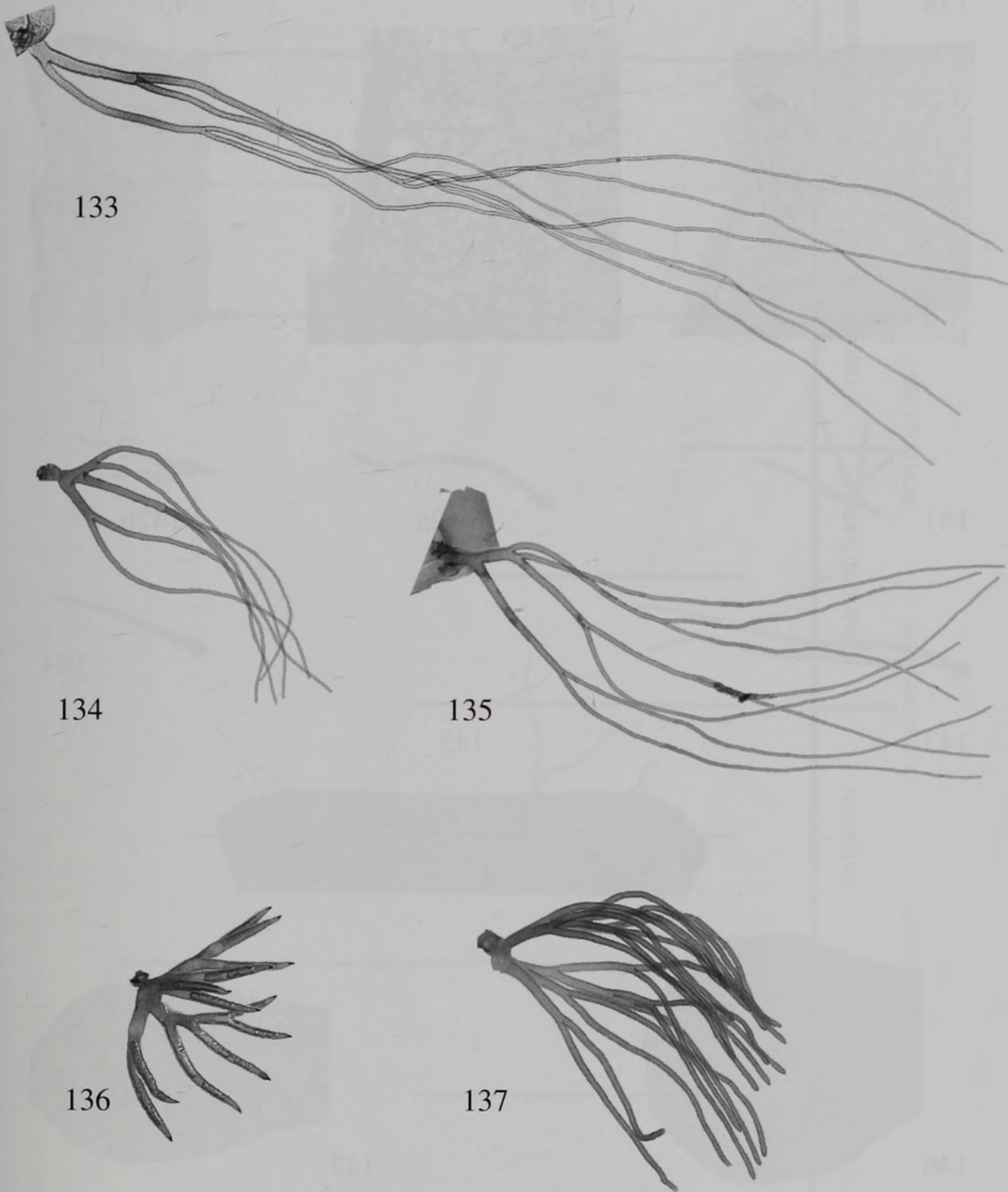


131



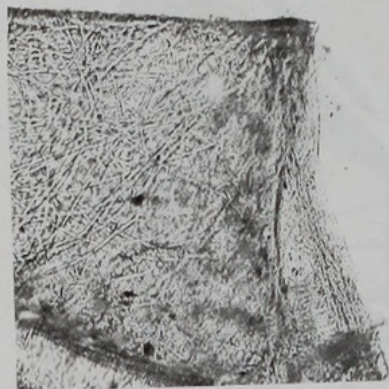
132

Figs. 127–132. Pupal gill of: 127. *S. spinibranchium*; 128. *S. subpallidum*; 129. *S. exiguum* s.l.; 130. *S. cuasiexiguum*; 131. *S. auripellitum*; 132. *S. incrustatum*.



Figs. 133–137. Pupal gill of: 133. *S. angrense*; 134. *S. minusculum*; 135. *S. lutzianum*; 136. *S. guianense* s.l.; 137. *S. nigrimanum*.

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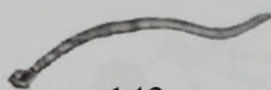
140



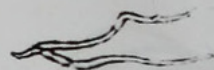
141



142a



142b



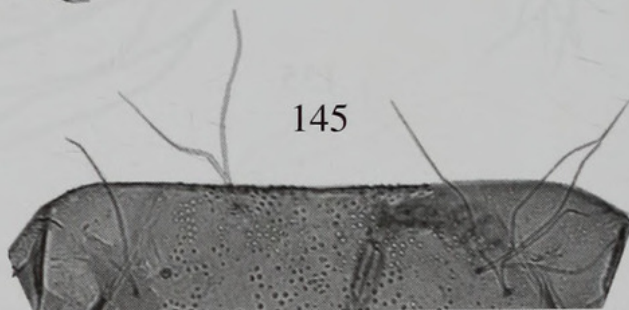
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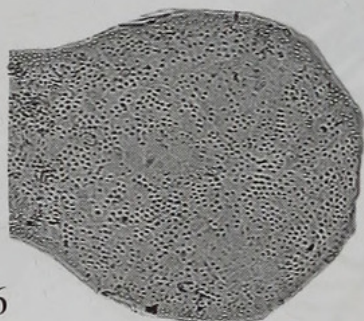
144



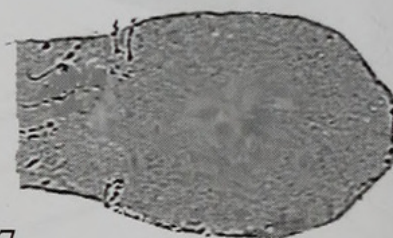
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147



Figs. 138–147. Cocoon texture of: 138. *S. subpallidum*; 139. *S. exiguum s.l.*; 140. *S. lutzianum*. Trichomes of pupa of: 141. *S. subpallidum*; 142a & b. *S. exiguum s.l.*; 143. *S. auripellitum*; 144. *S. auripellitum* (anchor pattern); 145. *S. angrense* (with part of frontoclypeus). Frontoclypeus showing presence or absence of tubercles: 146. *S. exiguum s.l.*; 147. *S. minusculum*.

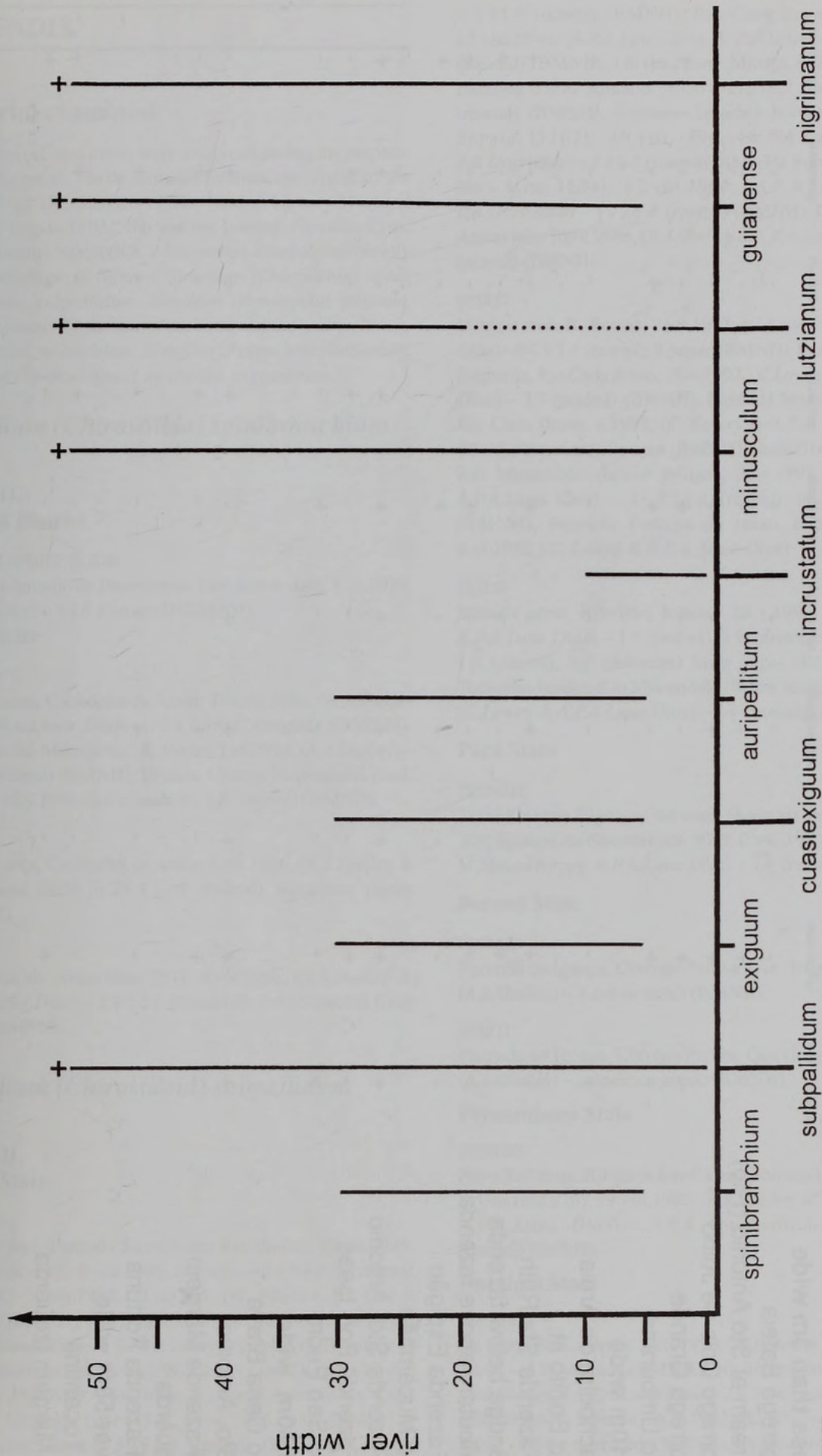


Fig. 148. Breeding grounds of simuliid species in the Minaçu area of Brazil.

Table 1. Breeding grounds of simuliid species in the Minaçu area.

LOCALITY	SPECIES									
	spinibranchium	subpallidum	exiguum	cuasiexiguum	auripellitum	incrustatum	minusculum	luzianum	guanense	nigrimanum
Less than 3m wide										
Corrego Bateia	-	-	-	-	-	+	-	-	-	-
Stream at Sto Antonio (Filó)	-	+	-	-	-	-	-	-	-	-
Corrego Dois de Julho	-	+	-	+	-	+	-	-	-	+
Corrego Grande	-	+	-	-	-	+	-	-	-	+
Rio Umburana	-	+	-	-	-	+	-	+	-	-
5-10m wide										
Cachoeira da Areia	+	-	-	-	-	-	-	-	-	+
Rio Bonito at:										
Fazenda Sta. Ruth	-	+	-	+	-	+	-	-	-	+
Bridge below fazenda	-	+	-	-	-	-	-	-	-	+
tributary above fazenda	-	+	-	-	-	+	-	-	-	-
Fazenda Espigão	-	-	-	-	-	+	-	-	-	+
Rio Mucambão										
Fazenda Sto. Antonio	+	+	+	+	+	+	+	-	+	+
Fazenda Fort Isaac	-	+	-	-	-	-	+	-	+	-
Rio Sao Pedro	-	-	-	-	-	+	-	-	-	-
20-30m wide										
Rio Cana Brava										
Sto. Antonio	+	+	+	+	+	-	+	+	+	-
Fazenda Margem	-	+	-	+	-	-	+	-	+	-
Izquerda										
Fazenda Fortuna	-	-	-	+	-	-	-	-	+	-
Over 50m wide										
R. Tocantins	-	-	-	-	-	-	+	-	+	-
R. Margem Izquerda	-	+	-	-	-	-	-	+	-	+

APPENDIX

Material examined

The following specimens were examined during the preparation of this paper. The depositaries for these specimens are the Entomology Departments of The Natural History Museum, London, England (BMNH) and the Instituto Oswaldo Cruz, Rio de Janeiro, Brazil (IOC). Species are listed alphabetically under subgenus as follows: *Simulium (Chirostilbia) spinibranchium*, *subpallidum*; *Simulium (Notolepria) exiguum*, *cuasiexiguum*; *Simulium (Psaroniocompsa) auripellitum*, *incrustatum*, *minusculum*; *Simulium (Psilopelmia) lutzianum*; *Simulium (Trichodagmia) guianense*, *nigrimanum*.

Simulium (Chirostilbia) spinibranchium Lutz

BRAZIL

Federal District

PINNED SPIRIT SLIDE

R. Santo Antonio de Descoberto, 1km below dam; 8.vi.1976, (A.J.Shelley) – 1 ♀ 1 ♂ (reared) (BMNH).

Goiás State

PINNED

Minaçu area, Cachoeira da Areia; 7–8.vii.1986, (A.J.Shelley and A.P.A.Luna Dias) – 5 ♀ ♀ 3 ♂ ♂ (reared) (BMNH). Niquelandia-Minaçu Rd., R. Buriti; 3.vi.1976, (A.J.Shelley) – 1 ♀ 1 ♂ (reared) (BMNH). Uruaçu, Uruaçu-Niquelandia road, stream; 15.v.1996 (S.Carvalho) – 1 ♂ (reared) (BMNH).

SPIRIT

Minaçu area, Cachoeira da Areia; 8.vii.1986, (A.J.Shelley & A.P.A.Luna Dias) – 2 ♀ ♀ 3 ♂ ♂ (reared), numerous pupae (BMNH).

SLIDE

Cachoeira da Areia (site 761); 8.vii.1986, (A.J.Shelley & A.P.A.Luna Dias) – 2 ♀ ♀ 2 ♂ ♂ (reared), 1 ♂ (dissected from pupa) (BMNH).

Simulium (Chirostilbia) subpallidum Lutz

BRAZIL

Goiás State

PINNED

Minaçu area: Fazenda Santa Ruth, Rio Bonito; 19.vii.1995, 22–23.viii.1995, 9.viii.1996, (Percil) – 4 ♀ ♀ 4 ♂ ♂ (reared) (BMNH), 22.vii.1995, 29.ix.1995, (M. Elias) – 8 ♀ ♀ 3 ♂ ♂ (reared) (BMNH). Rio Bonito (bridge) (site 742); 3.vii.1986, (A.P.A.Luna Dias) – 1 ♀ 2 ♂ ♂ (reared) (BMNH). Tributary of Rio Bonito (site 745); 3.vii.1986, (A.P.A.Luna Dias) – 1 ♀ 3 ♂ ♂ (reared) (BMNH). 1km from R. Santo Antonio da Cana Brava, Córrego (site 754); 5.vii.1986, (A.J.Shelley & A.P.A.Luna Dias) – 3 ♀ ♀ 1 ♂ (reared) (BMNH). Córrego Grande (site 765); 9.vii.1986, (A.J.Shelley & A.P.A.Luna Dias)

– 1 ♀ 1 ♂ (reared) (BMNH). Rio Cana Brava (site 1155); 15.viii.1996, (A.P.A.Luna Dias & P.R.Garritano) – 1 ♀ 1 ♂ (Reared) (BMNH). On road from Minaçu to Palmeiropolis, Fazenda Santo Antonio. 14.x.1991, (A.J.Shelley) – 2 ♀ ♀ (reared) (BMNH). Formoso-Trombos border, Corrego do Sapato (1167); 19.viii.1996, (A.P.A.Luna Dias & P.R.Garritano) – 1 ♀ 1 ♂ (reared) (BMNH). Formoso, Rio dos Bois (site 1154); 12.viii.1996, (A.P.A.Luna Dias & P.R.Garritano) – 1 ♀ 2 ♂ ♂ (reared) (BMNH). Ceres, Rio das Almas (site 769); 1986, (A.J.Shelley & A.P.A.Luna Dias) – 1 ♂ (reared) (BMNH).

SPIRIT

Minaçu area, R. Bonito; 26.v.1992, (C.Lowry & A.P.A.Luna Dias) – 6 ♀ ♀ 1 ♂ (reared), 8 pupae (BMNH). Fazenda Margem Esquerda, Rio Cana Brava; 28.v.1992, (C.Lowry & A.P.A.Luna Dias) – 1 ♀ (reared) (BMNH). Fazenda Margem Esquerda, Rio Cana Brava; v.1992, (C. Lowry & A.P.A. Luna Dias) – 4 ♀ ♀ 5 ♂ ♂ (reared), 9 pupae (BMNH). Goiás/Tocantins border, Rio Mucambão (below bridge); 30.v.1992, (C.Lowry & A.P.A.Luna Dias) – 5 ♀ ♀ 2 ♂ ♂ (reared), numerous pupae (BMNH). Fazenda Fortuna do Isaac, Rio Mucambão; 1.vi.1992, (C. Lowry & A.P.A. Luna Dias) – 1 ♀ (BMNH).

SLIDE

Minaçu area, Ribeirão Bonito; 26.v.1992, (C.Lowry & A.P.A.Luna Dias) – 1 ♀ (reared), 1 ♀ (dissected from pupa), 1 ♂ (reared), 1 ♂ (dissected from pupa) (BMNH). Goiás/Tocantins border, Rio Mucambão (below bridge); 30.v.1992, (C.Lowry & A.P.A.Luna Dias) – 1 ♀ (reared) (BMNH).

Pará State

PINNED

TransAmazon Highway between Maracaja and Pacajá, Km 220, Igarapé do Setenta (site 903); 7.viii.1993, (A.J.Shelley, M.Maia-Herzog, A.P.A.Luna Dias) – 1 ♂ (reared)(BMNH).

Paraná State

PINNED

Fazenda do Iguaçu, Córrego Pomba-Que (Itaipú); 8.xi.1980, (A.J.Shelley) – 4 ♂ ♂ (reared) (BMNH).

SPIRIT

Fazenda do Iguaçu, Córrego Pomba-Que (Itaipú); 8.xi.1980, (A.J.Shelley) – numerous pupae (BMNH).

Pernambuco State

PINNED

Nova Reforma, 20kms before Catendo on road from Caruaro, R.Una (site 916); 19.viii.1983, (A.J.Shelley, M.Maia-Herzog, A.P.A.Luna Dias) – 9 ♀ ♀ (oviposition swarm) 1 ♀ (reared)(BMNH).

Roraima State

PINNED

Nr. Bonfim, R. Arraia; 3.xii.1980, (A.J.Shelley & A.P.A.Luna Dias) – 1 ♀ (reared) (BMNH). Nr. Normandia; 3.xii.1989, (A.J.Shelley & A.P.A.Luna Dias) – 2 ♀ ♀ 1 ♂ (reared) (BMNH). Vila Pereira, R. Surumu; 26.xi.1980, (A.J.Shelley & A.P.A.Luna Dias) – 1 ♀ 4 ♂ ♂ (reared) (BMNH). Nr. Boa Vista, R. Murupú; 19.i.1979, (A.J.Shelley & A.P.A.Luna Dias) – 1 ♂ (reared)

(BMNH). Boa Vista-Santa Helena Rd., Igarapé, 70km from Boa Vista; 29.xi.1980, (A.J.Shelley & A.P.A.Luna Dias) – 1 ♂ (reared) (BMNH).

São Paulo State

PINNED

Cornelio Procopio to Ourinhos road, Km 20 near Ourinhos, Rio Laranjinha (site 884); 29.viii.1992, (A.J.Shelley) – 2 ♀ ♀ 1 ♂ (reared) (BMNH).

Simulium (Notolepria) exiguum Roubaud

BRAZIL

Amazonas State

PINNED

Mission post, R. Toototobi; 16.viii.1976, 25.x.1976, B.M.1979-580 (R.R.Pinger) 24.x.1976, 24.viii.1977, B.M.1979-580 (A.J.Shelley) – 11 ♀ ♀ (man-biting), 1 ♀ (man-biting), 5 ♀ ♀ (reared) (BMNH).

SPIRIT

R. Ituxi; v.1978, B.M.1979-580 (D.Roberts) – 12 ♀ ♀ (man-biting) (BMNH).

SLIDE

Mission post, R. Toototobi; 26.ii.1976, B.M.1979-580 (A.J.Shelley) – 1 ♀ (man-biting) (BMNH). R. Ituxi; v.1978, B.M.1979-580 (D.Roberts) – 1 ♀ (man-biting) (BMNH).

Federal District

SPIRIT

Córrego Papuda on DF 18 before R. São Bartolomeu; 18.iv.1976, B.M.1979-580 (A.J.Shelley) – 1 ♀ (reared) (BMNH). Brasília, under bridge on highway DF 6, R. São Bartolomeu; 12.iv.1976, B.M.1979-580 (B.Faustino) – 2 ♀ ♀ (reared) (BMNH). R. Palmeiras (Maranhão); 7.ix.1975, B.M.1979-580 (A.J.Shelley), 5.iv.1976, B.M.1979-580 (B.Faustino) – 2 ♀ ♀ (reared) (BMNH).

SLIDE

Brasília, under bridge on highway DF 6, R. São Bartolomeu; 12.iv.1976, B.M.1979-580 (B.Faustino) – 1 ♀ 1 ♂ (reared) (BMNH). R. Palmeiras (Maranhão); 5.iv.1976, B.M.1979-580 (B.Faustino) – 1 ♀ (reared) (BMNH).

Goiás State

PINNED

Campinaçu at the following localities: Estrada Campinaçu – balsa do Tocantins, à 23km de Campinaçu, Córrego Palmeirinha; 18.v.1996, (A.P.A.Luna Dias & P.Garritano) – 2 ♀ ♀ 1 ♂ (reared) (BMNH)(IOC). Estrada Campinaçu – balsa do Tocantins, à 23.5km de Campinaçu, Córrego do Rio Palmeirinha; 16.iv.1997, (A.P.A.Luna Dias & P.Garritano) – 3 ♀ ♀ (reared) (BMNH, IOC). Pote, Fazenda Santa Fé, R. Cristalino; 17.viii.1996, (A.P.A.Luna Dias & P.Garritano) – 2 ♀ ♀ 1 ♂ (reared) (BMNH, IOC). Estrada à Formoso, Rio Cristalino; 17.v.1996 & 24.viii.1996, (A.P.A.Luna Dias & P.Garritano) – 5 ♀ ♀ 2 ♂ ♂ (reared) (BMNH)(IOC). Minaçu at the following localities: Fazenda Margem Esquerda II, Rio Cana Brava; 15.viii.1996, (A.P.A.Luna Dias & P.Garritano) –

1 ♀ (reared) (BMNH). Fazenda Santo Antonio, R. Mucambão; 14.x.1991, (A.J.Shelley) – 1 ♀ 1 ♂ (reared) (BMNH). Rio Bateias (entre Cachoeira de Bateias e Agua Quente); 11.v.1996, (A.P.A.Luna Dias & P.Garritano) – 1 ♀ (reared) (BMNH). Rio Bateias (Serra da Mesa, na entrada pouco antes das águas quentes); 11.vi.1996, (A.P.A.Luna Dias & P.Garritano) – 1 ♂ (reared) (IOC). Formosa, Salto do Itiquira; 8.v.1996, (A.P.A.Luna Dias & P.Garritano) – 1 ♀ (reared) (IOC). Niquelândia, R. Traira, a 5km da cidade; 16.v.1996, (A.P.A.Luna Dias & P.Garritano) – 3 ♀ ♀ (reared) (BMNH) (IOC).

SLIDE

Formosa-Itiquira road, Córrego Bandeirinha; 23.iii.1976, B.M.1979-580 (A.J.Shelley) – 1 ♀ 1 ♂ (reared) (BMNH). State boundary with Tocantins, R. Mucambão; 30.v.1992, (C.A.Lowry & A.P.A.Luna Dias) – 2 ♀ ♀ 1 ♂ (reared) (BMNH).

Mato Grosso State

PINNED

R. Aripuanã; 29.vi.1978, B.M.1979-580 (J.D.Charlwood) – 30.v.1978 & 12.ix.1978 (L.A.Lacey) – 5 ♀ ♀ (1 with pupal exuviae), 3 ♂ ♂ (2 reared) (BMNH).

SPIRIT

R. Aripuanã; 29.vi.1978, B.M.1979-580 (J.D.Charlwood) – 1 exuviae (BMNH).

SLIDE

R. Aripuanã; 29.vi.1978, B.M.1979-580 (J.D.Charlwood) – 1 ♀ 1 ♂ (reared) (BMNH).

Roraima State

PINNED

Near Bonfim, R. Arraia; 28.xi. & 3.xii.1980, (A.J.Shelley & A.P.A.Luna Dias) – 3 ♀ ♀ 2 ♂ ♂ (reared) (BMNH). Catrimani mission, R. Catrimani; 9.i.1977 & 12, 13 & 16.i.1979, B.M.1979-580 (A.J.Shelley) & (A.J.Shelley & A.P.A.Luna Dias) – 1 ♀ (man-biting), 14 ♀ ♀ 7 ♂ ♂ (reared) (BMNH). R. Mucajaí, near mission post, 200m below Igarapé Coroconá; 21.vii.1984, (A.J.Shelley & A.P.A.Luna Dias) – 9 ♀ ♀ 5 ♂ ♂ (reared) (BMNH). Mucajaí mission post; 6.i.1977, B.M.1979-580 (A.J.Shelley) – 1 ♀ (reared) (BMNH). Northern perimeter road, R. Agua Preta; 18.xi.1980, (A.J.Shelley & A.P.A.Luna Dias) – 3 ♀ ♀ 2 ♂ ♂ (reared) (BMNH). Normandia, Igarapé Inamarú; 3.xii.1980, (A.J.Shelley & A.P.A.Luna Dias) – 1 ♀ (reared) (BMNH). Posto Meva, R. Auaris, 4°8'N, 64°29'W; 3.iv.1977, (R.R.Pinger) – 1 ♀ (caught at black light) (BMNH). R. Preto, tributary of R. Ajaraní; 28-29.iv.1979, B.M.1979-258 (R.W.Crosskey & A.J.Shelley) – 13 ♀ ♀ (reared, 1 pupal exuviae missing), 16 ♂ ♂ (reared, 1 pupal exuviae missing) (BMNH). R. Uaricoeira; 20.i.1979, B.M.1979-580 (A.J.Shelley & A.P.A.Luna Dias) – 1 ♀ 1 ♂ (reared) (BMNH). Vila Pereira, R. Surumu; 25 & 26.xi.1980 & 11.viii.1984, (A.J.Shelley & A.P.A.Luna Dias) – 1 ♀ (man-biting), 2 ♀ ♀ 7 ♂ ♂ (reared) (BMNH). Cachoeira, R. Cauamé; 2.xii.1984, (A.J.Shelley & A.P.A.Luna Dias) – 1 ♀ (reared) (BMNH). Uiramutã, Maloca Mudubim, Rio Cotingo; 25.x.1997, (A.J.Shelley & A.P.A.Luna Dias) – 1 ♀ (reared) (BMNH). Serra da Lua, Rio Urubu; 26.iv.1982, (A.P.A.Luna Dias & R.Malaguti) – 1 ♂ (reared) (BMNH).

SPIRIT

Catrimani mission, R. Catrimani; 9.i.1977, (*A.J.Shelley*) & 12.i.1979, B.M.1979-580, 13 & 14.vii.1984 (at intervals between 06.30 & 19.00 hrs), (*A.J.Shelley* & *A.P.A.Luna Dias*) – several ♀♀ (man-biting), 15 ♀♀ 12 ♂♂ (reared), numerous pupae (BMNH). Mission post, R. Auaris. 29.iii.1977, B.M.1979-580 (*R.R.Pinger*) – 1 ♀ (man-biting) (BMNH). Mucajaí; 20.vii.1984, (*A.J.Shelley* & *A.P.A.Luna Dias*) – 1 pupa (BMNH). Mission post, R. Mucajaí, Igarapé Coroconá; 21.vii.1984, (*A.J.Shelley* & *A.P.A.Luna Dias*) – 2 ♀♀ (reared), several pupae (BMNH). R. Mucajaí, 200m below Igarapé Coroconá; 21.vii.1984, (*A.J.Shelley* & *A.P.A.Luna Dias*) – 1 ♀ 1 ♂ (reared), several pupae (BMNH). R. Uraricoeira; 20.i.1979, B.M.1979-580 (*A.J.Shelley* & *A.P.A.Luna Dias*) – 1 ♂ (BMNH). Near Bonfim, R. Arraia; 3.xii.1980, (*A.J.Shelley*) – 3 ♀♀ 3 ♂♂ (reared), several pupae (BMNH). Northern perimeter road, R. Agua Preto; 29.iv.1979, B.M.1979-580 (*A.J.Shelley*) & 18.xi.1980, (*A.J.Shelley*) – 8 ♀♀ (reared, 4 without associated pupal exuviae), 9 ♂♂ (reared, 5 without associated pupal exuviae), several pupae (BMNH). Vila Pereira, R. Surumu; 25-27.xi.1980 & 11.viii.1984 (*A.J.Shelley*) – 5 ♂♂ (reared) (BMNH).

SLIDE

Near Bonfim, R. Arraia; 3.xii.1980, (*A.J.Shelley*) – 1 ♀ 1 ♂ (reared) (BMNH). Catrimani mission, R. Catrimani; 12.i.1979, B.M.1979-580 & 14.vii.1984 (*A.J.Shelley* & *A.P.A.Luna Dias*) – 7 ♀♀ (man-biting), 2 ♀♀ (reared), 7 ♂♂ (reared; 1 pupal exuviae missing) (BMNH), 1 ♂ (reared) (IOC). R. Mucajaí, near mission post; 21.vii.1984, (*A.J.Shelley* & *A.P.A.Luna Dias*) – 1 ♀ (reared) (BMNH). R. Mucajaí, 200m below Igarapé Coroconá; 21.vii.1984, (*A.J.Shelley* & *A.P.A.Luna Dias*) – 1 ♀ 3 ♂♂ (reared) (BMNH). R. Mucajaí, near mission post, Igarapé Coroconá; 21.vii.1984, (*A.J.Shelley* & *A.P.A.Luna Dias*) – 1 ♀ (reared) (BMNH). Northern Perimeter Road, R. Agua Preta; 29.iv.1979, B.M.1979-580 (*A.J.Shelley* & *A.P.A.Luna Dias*) & 18.xi.1980 (*A.J.Shelley*) – 2 ♀♀ (reared), 1 ♂ (reared) (BMNH). R. Uraricoeira; 20.i.1979, B.M.1979-580 (*A.J.Shelley* & *A.P.A.Luna Dias*) – 1 ♂ (reared) (BMNH). Vila Pereira, R. Surumu; 25 & 27.xi.1980, (*A.J.Shelley* & *A.P.A.Luna Dias*) – 2 ♀♀ 1 ♂ (reared) (BMNH). Cachoeira do R. Cauamé; 22.xi.1980, (*A.J.Shelley*) – 1 ♀ (reared) (BMNH).

São Paulo State

PINNED

2–3km east of Bananal Road, Fazenda Barra de Turvo stream; 16.v.1979, (*R.W.Crosskey* & *A.J.Shelley*) – 1 ♀ (reared) (BMNH).

Simulium (Notolepria) cuasiexiguum
Shelley, Luna Dias, Maia-Herzog & Lowry

Type specimens

BRAZIL

Goiás State

PINNED

Ceres, Rio das Almas; 10.vii.1986, (*A.J.Shelley* & *A.P.A.Luna Dias*) – 1 ♂ (reared) [PARATYPE] (BMNH). Minaçu at the

following localities: Fazenda Margem Esquerda II, Rio Cana Brava; 15.viii.1996, (*A.P.A.Luna Dias*) – 2 ♀♀ (reared) [PARATYPES] (BMNH, IOC). Fazenda Santo Antonio, Rio Mucambão; 14.x.1991, (*A.J.Shelley*) – 1 ♀ 2 ♂♂ (reared) [PARATYPES] (BMNH, IOC). Rio Bonito, acima da entrada da cidade; 13.iv.1997, (*A.P.A.Luna Dias* & *P.Garritano*) – 4 ♀♀ 3 ♂♂ (reared) [PARATYPES] (BMNH, IOC). Rio Bonito; 13.iv.1998, (*A.P.A.Luna Dias* & *P.Garritano*) – 1 ♀ (reared) [PARATYPE] (IOC). Rio Bateias; 11.v.1996, (*A.P.A.Luna Dias* & *P.Garritano*) – 1 ♂ (reared) [PARATYPE] (IOC). Niquelandia, Povoado Traira, Rio Traira; 11.v.1998, (*A.P.A.Luna Dias* & *P.Garritano*) – 3 ♀♀ (reared), [PARATYPES] (IOC).

SLIDE

Minaçu at the following localities: Ribeirão Bonito; 26.v.1996, (*C.A.Lowry* & *A.P.A.Luna Dias*) – 1 ♀ (reared) [HOLOTYPE] (IOC), 3 ♀♀ 1 ♂ (reared) [PARATYPES] (BMNH, IOC). Fazenda Santo Antonio, R. Mucambão; 1.vi.1992, (*C.A.Lowry* & *A.P.A.Luna Dias*) – 1 ♀ (reared) [PARATYPE] (BMNH). Fazenda de Isaac, Rio Mucambão; 1.vi.1992, (*C.A.Lowry* & *A.P.A.Luna Dias*) – 1 ♂ (reared), 1 pupa [PARATYPES] (BMNH). Near Porangatú, Belém-Brasília road, Km 187, Rio São Patricio; 27.v.1976, (*A.J.Shelley*) – 1 ♀ (reared) [PARATYPE] (BMNH).

SPIRIT

Minaçu at the following localities: Rio Bonito; 26.v.1992, (*C.A.Lowry* & *A.P.A.Luna Dias*) – 4 ♀♀ 1 ♂ (reared), 4 pupae [PARATYPES] (BMNH, IOC). Santo Antonio de Cana Brava, Rio Cana Brava; 27.v.1992, (*C.A.Lowry* & *A.P.A.Luna Dias*) – 1 ♂ [PARATYPE] (BMNH). Border with Tocantins State, Rio Mucambão; 30.v.1992, (*C.A.Lowry* & *A.P.A.Luna Dias*) – 1 ♂ (reared) [PARATYPE] (IOC). Fazenda de Isaac, Rio Mucambão; 1.vi.1992, (*C.A.Lowry* & *A.P.A.Luna Dias*) – 2 ♀♀ 4 ♂♂ (reared) [PARATYPES] (BMNH, IOC). Fazenda Santo Antonio, Rio Mucambão; 1.vi.1992, (*C.A.Lowry* & *A.P.A.Luna Dias*) – 2 ♀♀ 1 ♂ (reared) [PARATYPES] (BMNH, IOC). Fazenda Margem Esquerda, Rio Cana Brava; 2.vi.1992, (*C.A.Lowry* & *A.P.A.Luna Dias*) – 1 ♀ (reared) [PARATYPE] (BMNH).

Mato Grosso State

PINNED

Fazenda Dona Inacia, Rio Jadarimani (tributary of Rio Vermelho) (site 813); 30.x.–1.xi.1990, (*A.P.A.Luna Dias* & *P.Garritano*), 1 ♀ 1 ♂ (reared) (BMNH).

Simulium (Notolepria) gonzalezi Vargas
& Díaz Nájera

BELIZE

PINNED

Nr Caya, Augustine; 27.vii.1961, (*D.J.Lewis*) – 23 ♀♀ (mule-biting) (BMNH).

SLIDE

Augustine; 27.vii.1961, (*D.J.Lewis*) – 1 ♀ (man-biting) (BMNH).

ECUADOR**Esmeraldas Province****PINNED, SPIRIT**

Numerous reared adults from the following localities: San Miguel de Cayapas, R. Cayapa & R. San Miguel de Cayapas; 17–19.vi.1981, (*A.J. Shelley & M. Arzube*) (BMNH). Tumbaviro, R. Sapallo Grande; 26.v. & 18.vi.1981, (*A.J. Shelley & M. Arzube*) (BMNH). Viruela & Calle Mansa, R. Grande (Cayapa); 24–27.v.1981, (*A.J. Shelley & M. Arzube*) (BMNH). Naranjal, R. Canandé; 25.ix.1983 & 21–24.vi.1985, (*A.J. Shelley & M. Arzube*) (BMNH).

SLIDE

San Miguel de Cayapas, R. San Miguel; 17.vi.1981, (*A.J. Shelley & M. Arzube*) – 3 ♀ ♀ 1 ♂ (reared) (BMNH). Calle Mansa, R. Grande (Cayapa); 27.v.1981, (*A.J. Shelley & M. Arzube*) – 1 ♂ (reared) (BMNH). Tumbaviro, R. Sapallo Grande; 24.v. & 18.vi.1981, (*A.J. Shelley & M. Arzube*) – 2 ♀ ♀ 2 ♂ ♂ (reared) (BMNH). Naranjal, Rio Canandé; 23 & 24.vi.1985, (*A.J. Shelley & M. Arzube*) – 1 ♂ (reared) (BMNH).

GUATEMALA**Departamento Chimaltenango****PINNED**

Finca Sibaja; 6.xi.1974, (*R. Garms*) – 3 ♀ ♀ (BMNH).

SLIDE

Departamento de Suchitepequez: Municipio de Chicacao, Finca Valle de Oro (site 3); 10.xi.1987, (*A.J. Shelley & W.S. Procnier*) – 1 ♂ (reared) (BMNH).

MEXICO**PINNED**

Tamazunchale, SLP; ix.1944, (*M. Macias*) – 1 ♀ (BMNH).

Chiapas State**SLIDE**

Tapachula, Finca Hamburgo; 19.x.1985, (*H. Aguirre S.*) – 2 ♀ ♀ (man-biting) (BMNH).

Veracruz State**SLIDE**

Cordoba; 15.ii.1948, (*L. Vargas*) – 1 ♀ (BMNH).

Simulium (Psaroniocompsa) auripellitum* Enderlein*Type material****PARAGUAY****PINNED**

Hohenau, 250m. 12.x.07, (*C. Schrottky*) – 1 ♀ [HOLOTYPE] – Staatliches Museum für Tierkunde, Dresden, Germany. [With determination label of Enderlein dated 1933]

Other material**ARGENTINA****Corrientes Province****PINNED**

Corrientes, 10km S.O. Sto Tomé, ruta 40; 17.vii.1972,

(*S. Coscarón*) – 1 ♀ (BMNH). Corrientes, Arroyo El Sombrito; 9.vii.1971, (*S. Coscarón*) – 1 ♀ (reared) (BMNH). Corrientes, 20km N. De Alvear; 17.vii.1972, (*S. Coscarón*) – 1 ♀ 1 ♂ (reared) (BMNH). Santa Fé, Arroyo El Ceibalito, s/r 11 921km n. de Peconquista; 25.viii.1972, (*S. Coscarón*) – 1 ♂ (reared) (BMNH).

BOLIVIA**PINNED**

Cochabamba: Carmelitas, nr La Angostura reservoir; 21.viii.1984, (*C.J. Schofield*) – 4 ♀ ♀ (man-biting) (BMNH).

BRAZIL**Federal District****PINNED**

Brasília-Formosa road, Ribeirão Pipiripau (site 138); 26.ix.1975, (*A.J. Shelley*) – 3 ♀ ♀ 1 ♂ (reared) (BMNH).

SPIRIT

Road DF3, Córrego Samambaia; 7.vi.1976, (*A.J. Shelley*) – 1 ♂ (reared) (BMNH). Road DF3, Córrego Tamanduá; 7.vi.1976, (*A.J. Shelley*) – 1 ♂ (reared) (BMNH). Rio Palmeiros (site 162); 5.iv.1976, (*B. Faustino*) – 1 ♀ (reared) (BMNH). 1km do Córrego Taquaril, córrego (site 254); 28.vi.1976, (*A.J. Shelley*) – 1 ♀ (reared) (BMNH). R. Palmeiras; 5.iv.1976, B.M.1979-580 (*B. Faustino*) – 3 ♂ ♂ (reared) (BMNH). Near Planaltina, Cachoeira Pipiripau; 27.iii.1976, B.M.1979-580 (*B. Faustino*) – 4 ♀ ♀ 4 ♂ ♂ (reared) (BMNH). Brasília-Formosa highway, R. Mestre D'Armas; 5.iv.1976, B.M.1979-580 (*B. Faustino*) – 1 ♀ (reared) (BMNH, IOC). Brasília, University Farm; 9.x.1975, B.M.1979-580 (*A.J. Shelley*) – 3 ♀ ♀ (BMNH).

SLIDE

Córrego Papuda, on DF 18 before R. São Bartolomeu; 18.iv.1976, B.M.1979-580 (*A.J. Shelley*) – 1 ♀ (reared), 2 ♂ ♂ (1 reared; 1 dissected from pupa) (BMNH). Brasília, University Farm; 9.x.1975, B.M.1979-580 (*A.J. Shelley*) – 4 ♀ ♀ (man-biting) (BMNH). R. Preto; 12.iv.1976, B.M.1979-580 (*B. Faustino*) – 4 ♀ ♀ (man-biting), 1 ♀ (reared), 1 ♂ (pupal exuviae missing) (BMNH). West D.F., DF 3, Córrego Samambaia; 7.vi.1976, B.M.1979-580 (*A.J. Shelley*) – 1 ♀ (reared) (BMNH). DF 3, 1km from R. Samambaia; 7.vi.1976, B.M.1979-580 (*A.J. Shelley*) – 2 ♂ ♂ (reared) (BMNH). West Brasília, 2km da Granja do Tamanduá, Córrego; 7.vi.1976, B.M.1979-580 (*A.J. Shelley*) – 1 ♀ (reared) (BMNH). BR DF 3, Córrego Tamanduá; 7.vi.1976, B.M.1979-580 (*A.J. Shelley*) – 1 ♂ (reared) (BMNH). 1km do Córrego Taquaril, Córrego; 28.vi.1976, B.M.1979-580 (*A.J. Shelley*) – 2 ♀ ♀ (reared) (BMNH).

Goiás State**PINNED**

Minaçu: Fazenda Santa Ruth, Rio Bonito (site 1); 27.ix.1995, 30.vi.1995, (*Percil*) – 1 ♀ (man-biting), 1 ♀ (reared) (BMNH). Fortaleza, Fazenda, Rio Tocantins (site 2); 26.ix.1995, (*Percil*) – 2 ♀ ♀ (man-biting) (BMNH). Near Minaçu above bridge on road from Campinaçu, Rio Bonito (site 1210); 13.iv.1997, (*A.P.A. Luna Dias & P. Garritano*) – 1 ♀ 2 ♂ ♂ (reared) (BMNH). Stream on road from Fazenda Jacina to Serra da Mesa dam

(site 1216); 18.iv.1997, (*A.P.A.Luna Dias & P.Garritano*) – 1 ♀ (reared) (BMNH). Road to Serra da Mesa dam, stream (site 1106); 14.v.1996, (*A.P.A.Luna Dias & P.Garritano*) – 1 ♂ (reared) (BMNH). Estrada para Colinas, 12km da antiga balsa, córrego (site 1283); 25.ix.1997, (*A.P.A.Luna Dias & P.Garritano*) – 1 ♀ 1 ♂ (reared) (BMNH). Minaçu-Campinaçu road Km 6 after Hits motel, road to Fazenda do Japonês, Km 3, stream, (site 1265); 1.vii.1997, (*A.P.A.Luna Dias & P.R.Garritano*) – 1 ♀ 2 ♂ (reared) (BMNH). 9km from Minaçu, Fazenda Espigão, Rio Bonito (site 748); 4.vii.1986, (*A.J.Shelley & A.P.A. Luna Dias*) – 3 ♀ ♀ (reared) (BMNH). Serra da Mesa, Posto da FUNAI. Córrego afluente do Rio Maranhão, no porto dos Ava-Canoeiros (site 1097); 11.v.1996, (*A.P.A.Luna Dias & P.R.Garritano*) – 2 ♀ ♀ (reared) (BMNH, IOC). Estrada Santo Antonio de Cana Brava to R. Mucambão, Rio Dois de Julho. 12.v. & 12.x.1991, (*A.J.Shelley*) – 2 ♀ ♀ (reared) (BMNH). Estrada Santo Antonio de Cana Brava to R. Mucambão, Fazenda São Pedro, Rio São Pedro; 12.x.1991, (*A.J.Shelley*) – 1 ♀ (reared) (BMNH). Santo Antonio de Cana Brava (site 4), Rio Cana Brava; 29.ix.1995, (*Percil*) – 1 ♀ (reared) (BMNH). Municipality of Palmeiropolis, R. Mucambão. 12.x.1991, (*A.J.Shelley*) – 1 ♀ (reared) (BMNH). Campinaçu, river at Km 300 of old Uruá-Campinaçu road (site 1112); 16.v.1996, (*S.C.Thiengo, M.Stort & P.C.dos Santos*) – 1 ♀ 1 ♂ (reared) (BMNH). Campinaçu, Fazenda Matinha, Córrego Matinha (site 1370); 10.v.1998, (*A.J.Shelley, M.Maia-Herzog, A.P.A.Luna Dias & P.Garritano*) – 1 ♀ 1 ♂ (reared) (IOC). Estrada Campinaçu – balsa do rio Tocantins, 17km from Campinaçu, Rio Palmeira (site 1120); 18.v.1996, (*A.P.A.Luna Dias & P.Garritano*) – 1 ♀ (reared) (BMNH). Estrada Campinaçu – balsa do rio Tocantins, 14km from Campinaçu, Rio Palmeira (site 1121); 18.v.1996, (*A.P.A.Luna Dias & P.Garritano*) – 2 ♂ (reared) (BMNH). Estrada Campinaçu – balsa do rio Tocantins, 13.6km from Campinaçu, stream (site 1214); 16.iv.1996, (*A.P.A.Luna Dias & P.Garritano*) – 2 ♀ ♀ 2 ♂ (reared) (BMNH). Estrada Campinaçu – balsa do rio Tocantins, 49km from Campinaçu, stream (site 1212); 16.iv.1997, (*A.P.A.Luna Dias & P.Garritano*) – 1 ♀ 1 ♂ (reared) (BMNH). Near Campinaçu, Pote, Córrego do Bispo (site 1160); 15 & 17.viii.1996, (*A.P.A.Luna Dias & P.Garritano*) – 1 ♀ 2 ♂ (reared) (BMNH). Pote, Córrego da União (site 1161); (*A.P.A.Luna Dias & P.Garritano*) – 1 ♂ (reared) (BMNH). Fazenda São Jorge, Rio Cristalino (site 1158); 15.viii.1996, (*A.P.A.Luna Dias & P.Garritano*) – 2 ♀ ♀ (reared) (BMNH). Fazenda Bom Jardim, córrego (site 1375); 14.v.1998, (*A.P.A.Luna Dias & P.Garritano*) – 1 ♀ (reared) (IOC). Estrada do Garimpo Pela-Ema, 3km depois do asfalto, córrego (site 1374); 14.v.1998, (*A.P.A.Luna Dias & P.Garritano*) – 3 ♀ ♀ 1 ♂ (reared) (IOC). Minaçu-Campinaçu border, unnamed stream 13°43'S 48°26'W (sites 1164, 1165); 18.viii.1996, (*A.P.A.Luna Dias & P.Garritano*) – 1 ♀ 3 ♂ (reared) (BMNH). Rio Boa Nova, (sites 1122, 1126, 1215, 1264); 19.viii.1996, 21.v.1996, 18.iv.1997, 30.vi.1997, (*A.P.A.Luna Dias & P.Garritano*) – 3 ♀ ♀ 3 ♂ (reared) (BMNH). Minaçu-Formoso road, 88km from Minaçu, small stream (site 1113); 17.v.1996, (*A.P.A.Luna Dias & P.Garritano*) – 1 ♀ (reared) (BMNH). Formoso, 4km from roundabout, Córrego Cana Brava (site 1162); 17.viii.1996, (*A.P.A.Luna Dias & P.Garritano*) – 2 ♂ (reared) (BMNH). Rio Sta Teresa (site 1150); 12.viii.1996, (*A.P.A.Luna*

Dias & P.Garritano) – 2 ♀ ♀ 2 ♂ (reared) (BMNH). Formoso, Rio Bonito, (site 1151); 12.iii.1996, 14.viii.1996, (*A.P.A.Luna Dias & P.Garritano*) – 1 ♀ 1 ♂ (reared), 7 ♀ ♀ 1 ♂ (reared) (BMNH). Formoso, Fazenda N. Sra. Aparecida, R. Sta Tereza (site 1367); 10.v.1998, (*A.J.Shelley, M.Maia-Herzog, A.P.A.Luna Dias & P.Garritano*) – 1 ♀ (reared) (IOC). Formoso, Rio Pipoca (site 1368); 10.v.1998, (*A.J.Shelley, M.Maia-Herzog, A.P.A.Luna Dias & P.Garritano*) – 1 ♀ (reared) (IOC). Formoso-Tromba road Km 7, Córrego do Lage (site 1166); 19.viii.1996, (*A.P.A.Luna Dias & P.Garritano*) – 1 ♂ (reared) (BMNH). Formoso-Trombas border, Córrego do Sapato, (site 1167); 19.viii.1996, (*A.P.A.Luna Dias & P.Garritano*) – 1 ♂ (reared) (BMNH). Pirancajuba, Córrego Taioba (site 1127); 26.v.1996, (*A.P.A.Luna Dias & P.Garritano*) – 1 ♀ (reared) (BMNH).

SPIRIT

Minaçu area: Fazenda São Raimundo, Rio Dois de Julho; 5.vii.1986, (*A.J.Shelley & A.P.A. Luna Dias*) – 2 ♂ (reared) (BMNH). Ribeirão Bonito; 26.v.1992, iii, vi, vii, viii.1995, (*M. Camargo, C. Lowry & A.P.A. Luna Dias*) – 10 ♀ ♀ (reared), numerous ♀ ♀ (man-biting), 3 ♂ (reared), 5 pupae (BMNH). Fortaleza, R. Tocantins; vii.1995, (*M. Camargo*) – 3 ♀ ♀ (man-biting) (BMNH). Goiás/Tocantins border, Rio Mucambão (below bridge) (site 846); 30.v.1992, (*C. Lowry & A.P.A. Luna Dias*) – 2 ♀ ♀ (reared), 1 pupa (BMNH). Santo Antonio da Cana Brava, Rio Cana Brava (site 843); 1.vi.1992, (*C. Lowry & A.P.A. Luna Dias*) – 2 ♀ ♀ (reared) (BMNH). Estrada Padre Bernado-Dois Irmãos Km 39, Ribeirão das Pedras; 4.vi.1976, (*A.J.Shelley*) – 3 ♀ ♀ 3 ♂ (reared) (BMNH). Estrada Niquelandia-Dois Irmãos, Km 39, R. das Pedras; 4.vi.1976, B.M.1979-580 (*A.J.Shelley*) – 1 ♀ 1 ♂ (reared) (BMNH). Estrada Padre Bernado-Dois Irmãos Km 44, Córrego Dois Irmãos; 2.v.1976, (*A.J.Shelley*) – 1 ♀ (reared) (BMNH). Estrada Niquelandia-Dois Irmãos, Km 59, Córrego; 4.vi.1976, (*A.J.Shelley*) – (BMNH). Estrada Niquelandia-Dois Irmãos, Km 39, Rio das Pedras (site 235); 4.vi.1976, (*A.J.Shelley*) – 1 ♂ (reared) (BMNH). Estrada Niquelandia-Uruaçu, Km 6, Córrego do Cigano; 3.vi.1976, (*A.J.Shelley*) – 1 ♂ (reared) (BMNH). Belém-Brasília road, Km 22, Córrego; 26.v.1976, B.M.1979-580 (*A.J.Shelley*) – 1 ♂ (reared), 3 pupal exuviae (BMNH). Brasília-Campos Belos road, Km 39 from junction with Brasília-Formosa highway, stream (site 192); 23.iv.1976, B.M.1979-580 (*A.J.Shelley*) – 4 ♂ (2 with associated exuviae), 1 pupa (BMNH). Brasília-Campos Belos road, Km 138 from junction with Brasília-Formosa highway, stream (site 190); 23.iv.1976, B.M.1979-580 (*A.J.Shelley*) – 4 ♂ (reared) (BMNH). Brasília-Campos Belos road, Km 170 from junction with Brasília-Formosa highway, stream; 23.iv.1976, B.M.1979-580 (*A.J.Shelley*) – 1 pupa (BMNH). Brasília-Campos Belos road, Km 237 from junction with Brasília-Formosa highway, stream (site 180); 22.iv.1976, B.M.1979-580 (*A.J.Shelley*) – 1 ♀ 1 ♂ (reared), numerous pupae, (BMNH, IOC). Brasília-Campos Belos road, Km 239 from junction with Brasília-Formosa highway, stream; 22.iv.1976, B.M.1979-580 (*A.J.Shelley*) – 1 ♂ (reared), (BMNH). Brasília-Campos Belos road, Km 250 from junction with Brasília-Formosa highway, stream; 22.iv.1976, B.M.1979-580 (*A.J.Shelley*) – 3 pupae (BMNH). Brasília-Formosa road, bridge, R. Pipiripau (site 138);

26.ix.1975, 31.x.1975, 23.iii.1976, B.M.1979-580 (*A.J.Shelley*) – 6♂♂ (reared; 2 without associated pupal exuviae), 13 pupae, 13 pupal exuviae (BMNH). Mambai; 14.vii.1975, B.M.1979-580 (*A.J.Shelley*) – 1 pupa, 1 pupal exuviae (BMNH).

SLIDE

Brasília-Formosa road, bridge, R. Pipiripau; 26.ix.1975 & 31.x.1975, B.M.1979-580 (*A.J.Shelley*) – 9♀♀6♂♂ (reared) (BMNH). Belém-Brasília road, Córrego Riboleiro; 26.v.1976, B.M.1979-580 (*A.J.Shelley*) – 1♂ (reared) (BMNH). Belém-Brasília road, Km 11, Córrego; 26.v.1976, B.M.1979-580 (*A.J.Shelley*) – 1♀ (reared) (BMNH). Belém-Brasília road, Km 22, Córrego; 26.v.1976, B.M.1979-580 (*A.J.Shelley*) – 1♀1♂ (reared) (BMNH). Belém-Brasília road, Km 72, Córrego; 26.v.1976, B.M.1979-580 (*A.J.Shelley*) – 1♂ (reared) (BMNH). Belém-Brasília road, Km 238, Córrego; 27.v.1976, B.M.1979-580 (*A.J.Shelley*) – 1♀ (reared) (BMNH). Brasília-Campos Belos road, Km 237 from junction with Brasília-Formosa highway, stream; 22.iv.1976, B.M.1979-580 (*A.J.Shelley*) – 1♀ (reared) (BMNH). Brasília-Campos Belos road, Km 138 from junction with Brasília-Formosa highway, stream; 23.iv.1976, B.M.1979-580 (*A.J.Shelley*) – 2♂♂ (reared) (BMNH). Estrada Niquelandia-Dois Irmãos, Km 59, Córrego; 4.vi.1976, B.M.1979-580 (*A.J.Shelley*) – 1♂ (reared) (BMNH). Estrada Padre Bernardo-Dois Irmãos, Km 2, Córrego; 2.vi.1976, B.M.1979-580 (*A.Taitson*) – 2♀♀ (1 reared; 1 dissected from pupa), 2♂♂ (1 reared; 1 dissected from pupa) (BMNH). Estrada Padre Bernardo-Dois Irmãos, Km 43, Córrego Faz Tudo; 4.vi.1976, B.M.1979-580 (*A.J.Shelley*) – 1♂ (reared) (BMNH). Estrada Padre Bernardo-Dois Irmãos, Km 44, Córrego Dois Irmãos; 2.vi.1976, B.M.1979-580 (*A.Taitson*) – 1♀ (reared) (BMNH). Minaçu area: R.Bonito; 17.iii & vi.1995, (*M.Camargo*) – 4♀♀ (man-biting); 26.v.1992, (*C.Lowry & A.P.A.Luna Dias*) – 3♀♀3♂♂ (reared); 13.iv.1997, (*A.P.A.Luna Dias & P.Garritano*) – 1♀ (reared) (BMNH). 9km from Fazenda Espigão, Rio Bonito (site 748); 4.vii.1986, (*A.J.Shelley & A.P.A.Luna Dias*) – 1♀1♂ (reared) (BMNH). Córrego Grande (site 765); 9.vii.1986, (*A.J.Shelley & A.P.A.Luna Dias*) – 2♀♀ (reared) (BMNH). Near Campinaçu, córrego 13.6km from Campinaçu (site 1214); 16.iv.1997, (*A.P.A.Luna Dias & P.Garritano*) – 1♀ (reared) (BMNH). Conceição do Tocantins, Rio Arraia (site 1235); 25.iv.1995, (*A.P.A.Luna Dias & P.Garritano*) – 1♀ (reared) (BMNH).

Mato Grosso State

PINNED

Near Rondonópolis, Rondonópolis-Guaratinga road, Fazenda Dona Inacia, tributary of Rio Vermelho, R.Tadarimani (site 809); 28.ix.1990, (*A.J.Shelley*) – 11♀♀ (reared) (BMNH). 100km from Rondonópolis on Campo Grande Road, unnamed stream (site 810); 31.x.1990, (*A.J.Shelley*) – 14♀♀3♂♂ (reared) (BMNH). Km 120 on Rondonópolis-Campo Grande Road, Fazenda José Fortes Bustamante, unnamed stream; 31.x.1990, (*A.J.Shelley*) – 1♀ (reared) (BMNH).

Minas Gerais State

PINNED

Conceição dos Ouros (near Pouso Alegre), R.Ilai (site 806);

27.x.1990, (*A.J.Shelley*) – 3♂♂ (reared) (BMNH). Diamantina, Cachoeira Sentinela (site 656); 25.vii.1983, (*A.P.A.Luna Dias & P.Garritano*) – 4♀♀ (reared) (BMNH). São Tomé das Letras, Cachoeira da Eubiose (site 708); 18.xii.1984, (*A.P.A.Luna Dias*) – 4♀♀2♂♂ (reared) (BMNH). São Tomé das Letras, unnamed stream on road to Cachoeira da Eubiose (site 709); 18.xii.1984, (*A.P.A.Luna Dias*) – 5♀♀ (reared) (BMNH).

Rio de Janeiro State

PINNED

Junction BR494 and 139-Barra Mansa-Pouso Seco Road, Córrego Pouso Seco, (collection no. 450); 15.v.1979, (*R.W.Crosskey & A.J.Shelley*) – 1♂ (reared) (BMNH).

Rio Grande do Sul State

PINNED

Pelotas to Santa Maria Road, 20km from Pedras, Arroyo Luis Karsten (site 872); 20.viii.1992, (*A.J.Shelley*) – 1♀1♂ (reared) (BMNH).

Santa Catarina State

PINNED

Road from São Joaquim to Lauro Muller, Rio Pelotas (site 867); 15.viii.1992, (*A.J.Shelley*) – 1♂ (reared) (BMNH). Nr Rio do Sul, Lontra, Alto de Subida; 14.viii.1992, (*A.J.Shelley*) – 1♀ (reared) (BMNH). Road from São Joaquim to Lauro Muller, Rio Pelotas; 15.viii.1992, (*A.J.Shelley*) – 1♀1♂ (reared) (BMNH). Rio do Posto (site 866); 15.viii.1992, (*A.J.Shelley*) – 7♀♀4♂♂ (reared) (BMNH). Road from São Joaquim to Lauro Muller, Rio Barrinho (site 868); 15.viii.1992, (*A.J.Shelley*) – 1♀1♂ (reared) (BMNH).

SLIDE

Sta Catarina-Curitiba-Parana road, Km 20 from state border, Rio Pirabeiraba (site 776); 17.xi.1986, (*A.J.Shelley & A.P.A.Luna Dias*) – 1♀ (reared) (BMNH).

São Paulo State

PINNED

Bananal to São José de Barreiros road (SP66), Fazenda Vargem Grande, small stream (Collection no. 456); 15-18.v.1979, (*R.W.Crosskey & A.J.Shelley*) – 1♀2♂♂ (reared) (BMNH). 12km west of São José de Barreiros road (SP66) Km 281, R.Seis Marias (collection no. 458); 15-18.v.1979, (*R.W.Crosskey & A.J.Shelley*) – 1♀1♂ (reared) (BMNH). Km 264 on SP66 west – São José de Barreiros – Queluz road, unnamed river (collection no. 460); 15-18.v.1979, (*R.W.Crosskey & A.J.Shelley*) – 1♀ (reared) (BMNH). Serra de Mantiqueira, SP183 north west of Cruzeiro, Km 57, stream (collection no. 461); 15-18.v.1979, (*R.W.Crosskey & A.J.Shelley*) – 1♂ (reared) (BMNH).

SPIRIT

Serra da Bocaina, Córrego Mae d'água; 5.iv.1978, (*A.J.Shelley & A.P.A.Luna Dias*) – 1♂ (reared) (BMNH).

Tocantins State

PINNED

Divinópolis do Tocantins, tributary stream of R.Araguaia,

17km from town (site 1262); 28.vi.1997, (A.P.A.Luna Dias & P.Garritano) – 8 ♀ ♀ 2 ♂ ♂ (reared) (BMNH). Pium, Rio Matuca (site 1226); 22.iv.1997, (A.P.A.Luna Dias & P.Garritano) – 1 ♀ (reared) (BMNH).

SLIDE

17km from Divinópolis (site 1262); 28.vi.1997, (A.P.A.Luna Dias & P.Garritano) – 1 ♀ (reared) (BMNH).

PARAGUAY

Canendiyu Department

SLIDE

Mbaracaju Reserve: Rio Jejui-mi; 18 & 24.vii.1996, (C.Nouzille & L.Lagache) – 3 ♀ ♀ 2 ♂ ♂ (reared) (BMNH). Horqueta-mi, Rio Jejui-mi; 23.vii.1996, (C.Nouzille & L.Lagache) – 1 ♀ 1 ♂ (reared) (BMNH). Horqueta-mi, Arroyo en Balbinotique; 3.vii.1996, (C.Nouzille & L.Lagache) – 1 ♀ (BMNH). Arroyo Guazu; 19.vii.1996, (C.Nouzille & L.Lagache) – 3 ♀ ♀ 4 ♂ ♂ (reared) (BMNH). West border of reserve, Arroyo Guazu; 19.vii.1996, (C.Nouzille & L.Lagache) – 2 ♀ ♀ (reared) (BMNH).

SPIRIT

Mbaracaju Reserve: Estacion biologico, Rio Jejui-mi; 18 & 26.i.1997, (A.C.P.Costa) – 5 ♀ ♀ (man-biting) (BMNH). Main camp (Posto Central)=(Estacion biologico), Rio Jejui-mi (site 2); 13.vi.1995, (A.J.Shelley) – 1 ♀ (man-biting) (BMNH). Path entering cerrado to east of reserve (site 10); 15.vi.1995, (A.J.Shelley) – numerous ♀ ♀ (man-biting) (BMNH). Chorro Morrote (site 7); 14.vi.1995, (A.J.Shelley) – 2 ♀ ♀ (man-biting) (BMNH). Arroyo Morrote (site 9); 14.vi.1995, (A.J.Shelley) – 2 ♀ ♀ (man-biting) (BMNH). Carapa, waterfall 5km from control post; 7.iv.1996, (collector unknown) – 1 ♀ (man-biting) (BMNH). Western border of reserve, Rio Jejui-mi; 24.vii.1996, (C.Nouzille & L.Lagache) – numerous ♀ ♀ ♂ ♂ (reared) (BMNH). Horqueta-mi, Arroyo Tacuara; 14.vi.1995, (A.J.Shelley) – 1 ♀ (man-biting) (BMNH). Arroyo Amambay; 22.vii.1996, (C.Nouzille & L.Lagache) – 3 ♀ ♀ (reared) (BMNH). West border of reserve, Arroyo Guazu; 19. & 22.vii.1996, (C.Nouzille & L.Lagache) – numerous ♀ ♀ ♂ ♂ (reared) (BMNH). 2850m east of Horqueta-mi, Arroyo en Balbinotique; 20.vii.1996, (C.Nouzille & L.Lagache) – numerous ♀ ♀ (man-biting) (BMNH). Horqueta-mi, Rio Jejui-mi; 23.vii.1996, (C.Nouzille & L.Lagache) – 3 ♀ ♀ 1 ♂ (reared) (BMNH). Posto central abandonado near Hacienda Valinotti (site 201); 15.vi.1995, (A.J.Shelley) – numerous ♀ ♀ (man-biting) (BMNH). Horqueta-mi, puesto de control, Rio Jejui-mi; 7.iv.1997, (A.C.Ferreira) – 6 ♀ ♀ (man-biting) (BMNH). Lagunita; 23.iii.1996, (A.C.Ferreira) – 5 ♀ ♀ (man-biting) (BMNH). Mbaracaju Reserve; no other collection data – 12 ♀ ♀ (man-biting) 1 ♀ (reared) (BMNH).

Simulium (Psaroniocompsa) incrustatum Lutz

Simulium incrustatum was dealt with comprehensively by Shelley *et al.* (1997) for which large numbers of specimens were examined. Only material held in the BMNH and IOC for Argentina, Brazil and Venezuela has been revised in the light of the discovery of *S.auripellitum* at Minaçú. Most specimens

recorded in the 1977 paper as *Simulium* sp. near to *S.incrustatum* have now been assigned to *S.auripellitum*. Specimens of *S.incrustatum* from Ecuador and Trinidad listed in Shelley *et al.* (1997) were not consulted in the current paper because of the absence of *S.auripellitum* in these countries.

Type material

BRAZIL

Minas Gerais State

PINNED, SLIDE

Mendes; 1910, (collector not stated) – pupa (on slide) [LECTOTYPE], 1 ♀, 1 ♂, [PARALECTOTYPES] (IOC). Alfenas; 10.x.1909, (collector not stated) – 1 ♀ (pinned) [PARATYPE] (IOC).

Rio de Janeiro State

PINNED

Mendes; 24.ix.1909, (collector not stated) – 1 ♀ (pinned) [PARATYPE] (IOC).

as *Simulium aequifurcatum* Lutz

BRAZIL

SLIDE

No collection locality; no date, (collector not stated), pupa (on slide) [HOLOTYPE] (IOC).

as *Simulium yarzabali* Ramírez Pérez

VENEZUELA

Amazonas State

PINNED, SLIDE

Dept. Atabapo, Sierra de Parima, 1050m, Mayuwëteri; 20 & 28.iv.1980 (J.Ramírez Pérez) – 2 ♀ ♀ (reared, pinned), 1 ♂ (reared, pinned with abdomen and pupal exuviae on slide), 1 pupal exuviae (on slide) [PARATYPES] (BMNH).

Other material

ARGENTINA

PINNED

E.P. Dorado, Salto, Sta. Elena; 8.vii.1965, (C.G.H.) – 1 ♀ (as *S. opalinifrons*) (BMNH). Misiones, Ao. Guavirá, 5km N.E. of Eldorado; 19.vii.1972, (S.Coscarón) – 1 ♀ (reared) (as *S. opalinifrons*) (BMNH).

BRAZIL

Amapá State

SPIRIT

R. Limão; 22.v.1982, (A.P.A. Luna Dias) – numerous ♀ ♀ (man-biting) (BMNH).

SLIDE

SUCAM Reserve, R. Limão Branco, tributary of Tracajatuba; 22.v.1982, (A.P.A.Luna Dias) – 10 ♀ ♀ (man-biting) (BMNH).

Espírito Santo State

PINNED SPIRIT SLIDE

30km from Linhares, Forest Reserve of Companhia Vale do

R. Doce, Córrego Rancho Alto; 28-30.vi.1978, B.M.1979-580 (*M.Aragão, O.Tavares & A.P.A.Luna Dias*) – 1 ♀ 1 ♂ (dissected from pupa) (BMNH).

Goiás State

PINNED

Minaçu-Campinaçu boundary, 40km from Minaçu, unnamed stream (site 1122); 19.v.1996, (*A.P.A.Luna Dias & P.Garritano*) – 1 ♀ (reared) (BMNH). Formoso, Rio dos Bois (site 1154); 12.viii.1996, (*A.P.A.Luna Dias & P.Garritano*) – 1 ♀ (reared) (BMNH). Stream 23.5km from Campinaçu to ferry on R.Tocantins, R.Palmeirinha (site 1213); 16.iv.1997, (*A.P.A.Luna Dias & P.Garritano*) – 1 ♀ (reared) (BMNH).

SPIRIT

Brasília-Campos Belos road, Km 239 from junction with Brasília-Formosa highway, stream; 22.iv.1976, B.M.1979-580 (*A.J.Shelley*) – 1 ♂ (reared) (BMNH).

SLIDE

Belém-Brasília road, Km 149, córrego (site 212); 26.v.1976, (*A.J.Shelley*) – 2 ♂ ♂ (reared) (BMNH). Estrada-Niquelandia-Dois Irmãos, Km 59, córrego (site 239); 4.vi.1976, (*A.J.Shelley*) – 1 ♂ (reared) (BMNH). Minaçu area, Córrego Grande (site 765); 1 ♀ (BMNH).

Minas Gerais State

PINNED

Lassance, carro; 26.vi.1980, (*A.P.A.Luna Dias & P.Garritano*) – 1 ♀ (man-biting) (BMNH). Pirapora, R. São Francisco; 29.vi.1980, (*A.P.A.Luna Dias & P.Garritano*) – 1 ♀ (man-biting) (BMNH). Corinto, R. das Velhas; 21.vii.1980, (*A.P.A.Luna Dias & P.Garritano*) – 1 ♀ (man-biting) (BMNH). Corinto road (Km 70), Fazenda Olaria, (12km from Curvelo), Córrego Rocinha; 15.xii.1978, B.M.1979-580 (*A.J.Shelley & A.P.A.Luna Dias*) – 4 ♀ ♀ 1 ♂ (reared) (BMNH). Corinto road (Km 70), Fazenda Cachoeira, (8km from curve 10), Córrego de Caveira; 15.xii.1978, B.M.1979-580 (*A.J.Shelley & A.P.A.Luna Dias*) – 1 ♀ (reared) (BMNH). Corinto, R. Cangalha; 2.vii.1980, (*A.P.A.Luna Dias & P.Garritano*) – 1 ♀ 2 ♂ ♂ (reared) (BMNH). São Tomé das Letras, Cachoeira da Eubiose (site 708); 18.xii.1984, (*A.P.A.Luna Dias*) – 2 ♀ ♀ 1 ♂ (reared) (BMNH). São Tomé das Letras, unnamed stream on road to Cachoeira da Eubiose (site 709); 18.xii.1984, (*A.P.A.Luna Dias*) – 2 ♀ ♀ 3 ♂ ♂ (reared) (BMNH). Delfim Moreira, Córrego no limite com Wenceslaw Brás; 19.v.1979, (*A.J.Shelley & A.P.A.Luna Dias*) – 1 ♀ 1 ♂ (reared) (IOC).

Paraná State

PINNED

Guarapuava, BR 277; 16.v.1986, (*A.P.A.Luna Dias & P.R.Garritano*) – 1 ♀ (reared) (IOC). Laranjeiras do Sul, R.Laranjeiras; 17.iv.1986, (*A.P.A.Luna Dias & P.R.Garritano*) – 1 ♀ (reared) (IOC).

Rio de Janeiro State

PINNED

Rio de Janeiro, Tijuca Forest, Córrego Cascatinha, 50m above waterfall; 7.ii.1979, B.M.1979-580 (*A.J.Shelley*) – 2 ♀ ♀ (1 reared) (BMNH, IOC). Xerem, Floresta do IBDF, 0.5km da estrada Registro; 21.ii.1979, B.M.1979-580 (*T.Travassos &*

A.J.Shelley) – 1 ♀ (reared) (BMNH). Xerem, Córrego João Pinto, Floresta do IBDF; 21.ii.1979, B.M.1979-580 (*T.Travassos & A.J.Shelley*) – 1 ♀ (reared) (BMNH). Itatiaia National Park, unnamed stream (locus 43); 23.v.1979, BM 1979-258 (*R.W.Crosskey & A.J.Shelley*) – 1 ♀ (reared) (BMNH). Itaguaí, Sítio Porangaba, Córrego da Barragem; 10.xi.1983, (*A.P.A.Luna Dias*) – 1 ♀ (reared) (IOC).

Rio Grande do Sul State

PINNED

Road BR116 from Porto Alegre, nr Pelotas, Arroyo de Retiro (site 870); 18.viii.1992, (*A.J.Shelley*) – 2 ♀ ♀ (reared) (BMNH).

Roraima State

PINNED

Surucucus, Dalem; 11.xii.1986, (*A.J.Shelley & A.P.A.Luna Dias*) – 15 ♀ ♀ (man-biting), 1 ♀ (reared) (BMNH). Serra dos Surucucus, Igarapé do posta do FUNAI; 5.v.1982, (*A.P.A.Luna Dias & R.Malaguti*) – 4 ♀ ♀ (man-biting), 2 ♀ ♀ (BMNH, IOC). Serra dos Surucucus, Igarapé perto da Missão; 7.v.1982, (*A.P.A.Luna Dias & R.Malaguti*) – 2 ♂ ♂ (reared) (BMNH). Mission post, R. Auaris; 7 & 11.vii.1976, B.M.1979-580, 8.xii.1986, (*A.J.Shelley & A.P.A.Luna Dias*) & 4°8'N 64°29'W; 31.iii.1977 (*R.R.Pinger*) – 35 ♀ ♀ (man-biting), 5 ♀ ♀ 4 ♂ ♂ (reared) (BMNH, IOC). Igarapé Murupu, near Boa Vista; 19.i.1979, IOC 432 (*A.J.Shelley & A.P.A.Luna Dias*) – 25 ♀ ♀ (man-biting) (IOC). Near Boa Vista, R.Cauamé; 16.viii.1977, (*A.J.Shelley*) – 1 ♀ (man-biting) (IOC). Near Boa Vista, Igarapé Caraná; 16.viii.1977, (*A.J.Shelley*) – 6 ♀ ♀ (man-biting) (IOC).

SPIRIT

Mission post, R. Auaris; 29.iii.1977, B.M.1979-580 (*R.R.Pinger*) – 3 ♀ ♀ (man-biting) (BMNH). R. Mucajaí; 5.i.1977, B.M.1979-580 (*A.J.Shelley*) – 3 ♀ ♀ (man-biting) (BMNH). Surucucus, Dalem, (in river); 11.xii.1986, (*A.J.Shelley & A.P.A.Luna Dias*) – numerous ♀ ♀ (man-biting) (BMNH). Serra dos Surucucus, FUNAI Post; 6.v.1982, (*A.P.A.Luna Dias & R.Malaguti*) – 6 ♀ ♀ (man-biting) (BMNH). Serra dos Surucucus, American mission, Igarapé; 12.v.1982, (*A.P.A.Luna Dias & R.Malaguti*) – 1 ♂ (reared) (BMNH).

SLIDE

Mission post, R. Auaris; 7 & 11.vii.1976, B.M.1979-580 (*A.J.Shelley*) & 8.xii.1986 (*A.J.Shelley & A.P.A.Luna Dias*) & 29.iii.1977, B.M.1979-580 (*R.R.Pinger*) – 5 ♀ ♀ (man-biting) (1 head only, remainder pinned) (BMNH). R. Mucajaí; 5.i.1977, (*A.J.Shelley*) – 2 ♀ ♀ (man-biting) (BMNH). Surucucus, Dalem; 11.xii.1986, (*A.J.Shelley & A.P.A.Luna Dias*) – 12 ♀ ♀ (man-biting) (BMNH). Serra dos Surucucus, American mission, igarapé; 12.v.1982, (*A.P.A.Luna Dias & R.Malaguti*) – 2 pupal exuviae (associated ♀ and ♂ in spirit) (BMNH, IOC).

Santa Catarina State

PINNED

State boundary on BR 101, R. São João; 18.xi.1986, (*A.J.Shelley & A.P.A.Luna Dias*) – 9 ♀ ♀ 4 ♂ ♂ (reared) (BMNH). Santa Catarina-Curitiba-Paraná road, Km 20 from state border, R. Pirabeiraba; 17.xi.1986, (*A.J.Shelley & A.P.A.Luna Dias*) – 3 ♀ ♀ 2 ♂ ♂ (reared) (BMNH).

SPIRIT

15km from Paraná/Sta. Catarina frontier, R. Garuva; 18.xi.1986, (*A.J.Shelley & A.P.A.Luna Dias*) – several pupae (BMNH). Sta. Catarina-Curitiba-Paraná road, Km 20 from state border, R. Pirabeiraba; 17.xi.1986, (*A.J.Shelley & A.P.A.Luna Dias*) – several pupae (BMNH). State boundary on BR 101, R. São João; 18.xi.1986, (*A.J.Shelley & A.P.A.Luna Dias*) – 1 ♀ 4 ♂ (reared), numerous pupae (BMNH).

SLIDE

Santa Catarina-Curitiba-Paraná road, Km 20 from state border, R. Pirabeiraba; 17.xi.1986, (*A.J.Shelley & A.P.A.Luna Dias*) – 1 ♀ (man-biting), 4 ♀ ♀ (reared), 4 ♂ ♂ (reared); 1 pupal exuviae missing; 1 dissected from pupa), 2 pupal exuviae (BMNH). State boundary on BR 101, R. São João; 18.xi.1986, (*A.J.Shelley & A.P.A.Luna Dias*) – 3 ♀ ♀ 1 ♂ (reared) (BMNH).

São Paulo State

PINNED

Serra da Bocaina, Fazenda da Bonito (site 350); 6.iv.1978, B.M.1979-580 (*A.J.Shelley & A.P.A.Luna Dias*) – 17 ♀ ♀ (horse-biting), 18 ♀ ♀ 11 ♂ ♂ (reared) (BMNH, IOC). SP66 road from Bananal to São José de Barreiros, Km 302, small stream; 16.v.1979, (*R.W.Crosskey & A.J.Shelley*) – 1 ♀ (man-biting) (BMNH).

SPIRIT

Serra da Bocaina, Fazenda Bonito, R. Bonito; 5.iv.1978, B.M.1979-580 (*A.J.Shelley*) – 1 ♀ 1 ♂ (both reared but without associated pupal exuviae), numerous pupae (BMNH). Serra da Bocaina, Fazenda Bonito, stable; 6.iv.1978, B.M.1979-580 (*A.J.Shelley & A.P.A.Luna Dias*) – 25 ♀ ♀ (horse-biting), several ♀ ♀ (man-biting) (BMNH, IOC).

SLIDE

Serra da Bocaina, 200m before IBDF headquarters, stream; 4.iv.1978, B.M.1979-580 (*A.J.Shelley & A.P.A.Luna Dias*) – 1 ♂ (reared) (BMNH). Serra da Bocaina, Fazenda da Bonito, R. Bonito; 5.iv.1978, B.M.1978-580 (*A.J.Shelley & A.P.A.Luna Dias*) – 1 ♀ (man-biting), 3 ♀ ♀ 2 ♂ ♂ (reared), 4 pupal exuviae (BMNH, IOC). Serra da Bocaina, Fazenda da Bonito, Cachoeira do Segredinho; 6.iv.1978, B.M.1979-580 (*A.J.Shelley & A.P.A.Luna Dias*) – 1 ♀ (reared) (BMNH). Serra da Bocaina, Fazenda da Bonito, R. Bonito; 5.iv.1978, (*A.J.Shelley*) – 1 ♀ (reared) (BMNH), stable; 6.iv.1978, B.M.1979-580 (*A.J.Shelley & A.P.A.Luna Dias*) – 2 ♀ ♀ (man-biting), 1 ♀ (man-biting) (BMNH, IOC).

Tocantins State

PINNED

Divinópolis, 17km from town, tributary of R.Araguaia, unnamed stream (site 1262); 28.vi.1997, (*A.P.A.Luna Dias & P.Garritano*) – 6 ♀ ♀ 1 ♂ (reared) (BMNH).

PARAGUAY

Canindeyu Department

SLIDE

Mbaracaju Reserve: Rio Jejui-mi; 23.vii.1996, (*C.Nouzille & L.Lagache*) – 1 ♀ (BMNH). Rio Jejui-mi, road to eastern limits of reserve near Hacienda Valinotti, small stream; 15.vi.1995, (*A.J.Shelley*) – 1 ♀ (man-biting) (BMNH).

Simulium (Psaroniocompsa) minusculum Lutz

BRAZIL

Goiás State

PINNED

Minaçu area: Minaçu; 30.ix.1995 (*M.Camargo*) – 3 ♀ ♀ (man-biting) (BMNH). Minaçu, Campus da SAMA (site 766); 9.vii.1986, (*A.J.Shelley & A.P.A.Luna Dias*) – 1 ♀ (man-biting) (BMNH). Rio Bonito, river above bridge on airport-Minaçu road; 13.iv.1997 (*A.P.A.Luna Dias & P.R.Garritano*) – 1 ♂ (reared) (BMNH). Rio Bonito, entrance to Minaçu from Campinaçu (site 1210); (*A.P.A.Luna Dias & P.R.Garritano*) – 1 ♂ (reared) (BMNH). Fortaleza Fazenda, Rio Tocantins (site 2); 27–28.ix.1995, (*Percil*) – 2 ♀ ♀ 6 ♂ ♂ (reared) (BMNH). Rio Maranhão [=Tocantins] (site 767); 9.vii.1986, (*A.J.Shelley & A.P.A.Luna Dias*) – 5 ♀ ♀ (man-biting), 1 ♂ (BMNH). São Jose I. Fazenda, Rio Mucambão (site 3); 9.iii.1996, (*Percil*) – 5 ♀ ♀ 3 ♂ ♂ (reared) (BMNH). Palmeiropolis Road, R. Mucambão (site M9); 12.x.1991, (*A.J.Shelley*) – 1 ♀ (reared) 1 ♀ (man biting) (BMNH). Santo Antonio da Cana Brava, Rio Cana Brava (site 4); 29–30.ix.1995, (*Percil*) – 8 ♀ ♀ 6 ♂ ♂ (reared) (BMNH). Rio Cana Brava (site 763); 8.vii.1986, (*A.J.Shelley & A.P.A.Luna Dias*) – 1 ♀ (man-biting), 1 ♂ (BMNH). Fazenda, Margem Esquerda, R. Cana Brava; 13.x.1991, (*A.J.Shelley*) – 1 ♀ (reared) (BMNH). Uruaçu, Buritis, R.Tocantins; 21.iv.1997, (*A.P.A.Luna Dias & P.R.Garritano*) – 1 ♀ (man-biting) (BMNH).

SPIRIT

Minaçu area, R. Bonito; iii, vii, viii.1995, (*M.Camargo*) – numerous ♀ ♀ (man-biting) (BMNH). R. Tocantins-Fortaleza; viii.1995, (*M.Camargo*) – numerous ♀ ♀ (man-biting) (BMNH). Road from Fazenda São Raimundo to Minaçu (22km from Fazenda); 5.vii.1986, (*A.J.Shelley & A.P.A.Luna Dias*) – numerous ♀ ♀ (man-biting) (BMNH). Ribeirão Bonito; 26.v.1992, (*C.Lowry & A.P.A.Luna Dias*) – 7 ♀ ♀ 2 ♂ ♂ (reared), 7 pupae (BMNH). Santo Antonio da Cana Brava, Rio Cana Brava; 27.v.1992, 1.vi.1992, (*C.Lowry & A.P.A.Luna Dias*) – 6 ♀ ♀ (man-biting), 7 ♀ ♀ 9 ♂ ♂ (reared) (BMNH). Fazenda Margem Esquerda, Rio Cana Brava; 28.v.1992, 2.vi.1992, (*C.Lowry & A.P.A.Luna Dias*) – 8 ♀ ♀ 3 ♂ ♂ (reared) (BMNH). Goiás/Tocantins border, Rio Mucambão (below bridge); 30.v.1992, (*C.Lowry & A.P.A.Luna Dias*) – 3 ♀ ♀ 4 ♂ ♂ (reared) (BMNH). Fazenda Santo Antonio, Rio Mucambão; 1.vi.1992, (*C.Lowry & A.P.A.Luna Dias*) – 3 ♀ ♀ 1 ♂ (reared) (BMNH). Fazenda Fortuna do Isaac, Rio Mucambão; 1.vi.1992, (*C.Lowry & A.P.A.Luna Dias*) – 1 ♀ (reared) (BMNH). R. Mucambão; iii, vii, viii.1995, (*M.Camargo*) – 30 ♀ ♀ (man-biting) (BMNH). Station 2, R.Tocantins; vi.1995, (*M.Camargo*) – 20 ♀ ♀ (man-biting) (BMNH). R. Tocantins-Fortaleza; iii, vii, viii.1995, (*M.Camargo*) – numerous ♀ ♀ (man-biting) (BMNH).

SLIDE

Minaçu area, Ribeirão Bonito; 26.v.1992, 16.iii.1995, (*C.Lowry & A.P.A.Luna Dias*) – 1 ♀ (reared), 1 ♀ (dissected from pupa), 1 ♀ (man-biting), 1 ♂ (reared), 1 ♂ (dissected from pupa) (BMNH).

Maranhão State

PINNED

30kms from Imperatriz on BR 010 to Araguaiana. Dirt road to Ribeirãozinho, R. Tocantins (collection site 902); 15.viii.1993 (A.J.Shelley, M. Maia-Herzog, A.P.A.Luna Dias) – 6 ♀ ♀ 5 ♂ ♂ (reared) (BMNH); BR 010 Estreito to Imperatriz, 7kms from R.Tocantins, R.Lajeado (collection site 912); 13.viii.1993 (A.J.Shelley, M. Maia-Herzog, A.P.A.Luna Dias) – 3 ♀ ♀ (reared) (BMNH).

Mato Grosso State

PINNED

Dardanelos Falls, R. Aripuana; 29.vi.1978, (J.D.Charlwood), 2.xi., 22.iii.1977 (J.Hayes), 20,30.v.1978, 12.ix.1978, (L.A.Lacey) – 50 ♀ ♀ (man-biting) (BMNH).

Minas Gerais State

PINNED

Lassance, Rio das Velhas; 27.vi.1980, 21–25.v.1981, (A.P.A.Luna Dias & P.R.Garritano) – 7 ♂ ♂ (reared) (BMNH).

SPIRIT

Lassance, Rio das Velhas (site 580); 21–25.v.1981, (A.P.A.Luna Dias & P.Garritano) – 23 ♀ ♀ 18 ♂ ♂ (reared), numerous pupae (BMNH).

SLIDE

Lassance, Rio das Velhas (site 580); 21–25.v.1981, (A.P.A.Luna Dias & P.Garritano) – 3 ♀ ♀ (man biting), 2 ♂ ♂ (reared), 5 pupae – (BMNH).

Piauí State

PINNED

São Gonçalo, 50kms from Corrente de Piauí, R.Gurgeia (collection site 899); 28–viii.1993, (A.P.A.Luna Dias & P.R.Garritano) – 1 ♀ (Man-biting) (BMNH).

Simulium (Psilopelmia) lutzianum* Pinto*Type material****VENEZUELA**

(as *S. lewisi* Ramírez Pérez)

Barinas State

PINNED

80km de Parinas, R. Socopo; [no date], (J.Ramírez) – 1 ♂ (reared) [PARATYPE] (BMNH).

Carabobo State

PINNED

Virigima; [no date], (J.Ramírez) – 1 ♀ (reared) [PARATYPE] (BMNH).

Miranda State

PINNED

Panaquire; [no date], B.M.1969–676 (J.Ramírez) – 1 ♀ (reared) [PARATYPE] (BMNH). Acevedo District, Panaquire, 70m, R. Yaguapo; [no date], (J.Ramírez) – 1 ♀ (reared) [PARATYPE] (BMNH).

Other material**BRAZIL****Goiás State**

PINNED

Campinaçu, Nr Formoso turn off, Corrego Cana Brava (site 1162); 17.viii.1996, (A.P.A.Luna Dias & P.Garritano) – 2 ♀ ♀ (reared) (BMNH). Campinaçu, Corrego do Bispo (site 1160); 17.viii.1996, (A.P.A.Luna Dias & P.Garritano) – 1 ♀ (reared) (BMNH). Minaçu area, Mata do Café road, R. Boa Nova; 20.v.1996, (A.P.A.Luna Dias & P.Garritano) – 1 ♂ (reared) (BMNH).

SLIDE

Minaçu area, Fazenda Margem Esquerda, Rio Cana Brava; 28.v.1992, (C.Lowry and A.P.A.Luna Dias) – 1 ♀ 1 ♂ (reared) (BMNH).

SPIRIT

Near Minaçu, Fazenda Margem Esquerda, R. Umburara; 13.x.1991, (A.J.Shelley) – 1 ♂ (reared) (BMNH).

Roraima State

SLIDE

Mission post, R. Auaris; 8.xii.1986, (A.J.Shelley & A.P.A.Luna Dias) – 1E (reared) (BMNH).

Santa Catarina State

SLIDE

State boundary on BR101, R. São João; 18.xi.1986, (A.J.Shelley & A.P.A.Luna Dias) – 1 ♂ (reared), 2 pupae, 2 exuviae (BMNH).

Simulium (Trichodagnia) guianense* Wise*Type material****GUYANA**

PINNED, SLIDE

Lower Rupununi R; 1908, (K.S.Wise) – 1 ♀ (pinned with head, abdomen, mid and hind legs on slide) [LECTOTYPE], 3 ♀ ♀ (pinned with abdomen, wing and hind leg on slide) [PARALECTOTYPES] (BMNH).

as *Simulium (Trichodagnia) pinto* Andretta & Andretta**BRAZIL****São Paulo State**

PINNED, SLIDE

Piracicaba; 28.vii.1944 (V.Andretta & Andretta Jr.) – 1 ♀ (reared with thorax pinned, remainder on slide no.999) [PARATYPE], 1 ♂ (head and thorax pinned with abdomen and hind leg on slide no.1020) [PARATYPE], 2 pupal exuviae (♂ on slide no.1014 & ♀ on slide no.987) [PARATYPES] (BMNH).

Other material**BRAZIL**

Amapá State

PINNED

Above Maripa Falls, R. Oyapock; 21.v.1992, (*C.Lowry & A.P.A.Luna Dias*) – 3 ♀ ♀ (reared) (BMNH).

SPIRIT

Above Maripa Falls, R. Oyapock; 21.v.1992, (*C.Lowry & A.P.A.Luna Dias*) – 1 ♂ (reared), several pupae (BMNH). R. Limão; 22.v.1982, (*A.P.A.Luna Dias*) – 15 ♀ ♀ (man-biting) (BMNH).

SLIDE

Above Maripa Falls, R. Oyapock; 21.v.1992, (*C.Lowry & A.P.A.Luna Dias*) – 1 ♀ (dissected from pupa) (BMNH). R. Limão; 22.v.1982, (*A.P.A.Luna Dias*) – 1 ♀ (man-biting) (BMNH).

Amazonas State

PINNED

Mission post, R. Toototobi; 24.x.1976, 26.ii.1976, 19.viii.1977, B.M.1979-580 (*A.J.Shelley*) – 6 ♀ ♀ (man-biting) (BMNH).

SPIRIT

R. Toototobi; 1.xii.1977, B.M.1979-580 (*A.J.Shelley*) – 1 ♀ (man-biting) (BMNH).

SLIDE

Mission post, R. Toototobi; 26.ii.1976, B.M.1979-580 (*A.J.Shelley*) – 4 ♀ ♀ (man-biting) (BMNH, IOC). R. Toototobi; 1.xii.1977, B.M.1979-580 (*A.J.Shelley*) – 2 ♀ ♀ (man-biting) (BMNH).

Goiás State

PINNED

Minaçu area: Rio Bonito; 23.viii.1995 17–18hrs – 1 ♀ (man-biting) (BMNH). Fortaleza Fazenda (site 2), Rio Tocantins; 28.viii., 27–28.ix, 30.ix.1995, 9.viii.1996, (*Percil*) – 11 ♀ ♀ 4 ♂ ♂ (reared), 1 ♀ (man biting) (BMNH). Rio Maranhão (=Tocantins) (site 768); 9.vii.1986, (*A.J.Shelley & A.P.A.Luna Dias*) – 1 ♀ 1 ♂ (reared) (BMNH). São Antonio da Cana Brava, Rio Cana Brava (site 4); 29–30.ix.1995, (*Percil*) – 1 ♀ 1 ♂ (reared) (BMNH). Road from Minaçu-Palmeiropolis, Fazenda Fortuna de Isaac, 1km below bridge (site M13); 14.x.1981, (*A.J.Shelley*) – 3 ♀ ♀ 3 ♂ ♂ (reared) (BMNH).

SPIRIT

Minaçu area, Rio Maranhão (=Tocantins); 9.vii.1986, (*A.J.Shelley & A.P.A.Luna Dias*) – 5 pupae (BMNH). Near Minaçu, 4km below hydroelectric works of Serra da Mesa, R. Tocantins; 11.x.1991, (*A.J.Shelley*) – 5 pupae, 2 pupal exuviae (BMNH). On road from Minaçu to Palmeiropolis, Fazenda Sto. Antonio, R. Mucambão; 14.x.1991, (*A.J.Shelley*) – 1 ♂ (reared), 3 pupae (BMNH). Fazenda Fortuna do Isaac, Rio Mucambão; 1.vi.1992, (*C.Lowry & A.P.A.Luna Dias*) – 2 ♀ ♀ 2 ♂ ♂ (reared), 6 pupae (BMNH). On road from Minaçu to Palmeiropolis, Fazenda do Fortuna do Isaac, R. Cana Brava, 1km below bridge; 14.x.1991, (*A.J.Shelley*) – 3 ♀ ♀ 4 ♂ ♂ (reared), 3 pupae, 2 pupal exuviae (BMNH). Brasília-Campos Belos road, Km 299 from junction with Brasília-Formosa highway, stream; 22.iv.1976, B.M.1979-580 (*A.J.Shelley*) – 2 pupae, 2 pupal exuviae (BMNH).

SLIDE

Minaçu area, R. Bonito; 22.viii.1995, (*M.Camargo*) – 1 ♀ (man-biting) (BMNH). Fazenda Fortuna do Isaac, R. Mucambão; 1.vi.1992, (*C.Lowry & A.P.A.Luna Dias*) – 1 ♀ 1 ♂ (reared) (BMNH). Fazenda Fortaleza, (Station 2; UNDP Project), Rio Tocantins; 28.viii.1995, (*M.Carmargo*) – 1 ♂ (reared) (BMNH).

Maranhão State

PINNED

30kms from Imperatriz on BR010 to Araguaiana. Dirt road to Ribeirãozinho, Rio Tocantins (collection site 902); 15.viii.1993, (*A.J.Shelley, M.Maia-Herzog, A.P.A.Luna Dias*) – 1 ♂ (reared) (BMNH).

Mato Grosso State

SPIRIT

R. Aripuanã, Dardenelos Falls; 5.x.1977, (*D.Charlwood*) – 1 ♀ (man-biting) (BMNH).

Pará State

PINNED

R. Iriri, 52°53'W, 3°50'S; vii.1984, (*T.Harvey*) – 3 ♀ ♀ 1 ♂ (reared) 21 ♀ ♀ (man biting) (BMNH). Altamira, 51°45'W, 3°33'S; vii.1984, (*T.Harvey*) – 40 ♀ ♀ (man-biting) (BMNH). Altamira, R.Xingu, 30kms downriver from Cachoeira Paratizão (collection site 908); 9.viii.1993, (*A.J.Shelley, M.Maia-Herzog, A.P.A.Luna Dias*) – 1 ♂ (BMNH). Uruá, R. Tapajós, 4°33'S, 56°19'W; 29.viii.1979, B.M.1979-580 (*L.A.Lacey*) – 35 ♀ ♀ (man-biting) (BMNH). Amazonia Nacional Park, Uruá, R. Tapajós; 1.ix.1978, B.M.1979-580 (*L.A.Lacey*) 4 ♀ ♀ (man-biting), 2 ♀ ♀ 3 ♂ ♂ (reared, but no exuviae) (BMNH). R. Anapu; 8.iv.1976, B.M.1979-580 (*W.Arouck*) – 4 ♀ ♀ (man-biting) (BMNH). Mission post, R. Toototobi, 63°39'W, 1°47'N; 12.xii.1976, B.M.1979-580, 12.xii.1976, (*R.R.Pinger*) – 3 ♀ ♀ (BMNH).

SPIRIT

Near Altamira, Laranjal, R. Iriri, 52°53'W 3°50'S; 1.iii.1984, vi.1984, (*T.Harvey*) – numerous ♀ ♀ (man-biting) (BMNH). Near Altamira, 100km south southwest of Pirauhaguara, R. Xingu, 52°34'W 4°8'S; 7.ii.1984, (*T.Harvey*) – several ♀ ♀ (man-biting) (BMNH). Near Itaituba, R. Uruá; 12.x.1977, B.M.1979-580 (*B.Ratcliffe*) – 1 ♀ (man-biting) (BMNH). Km 360 Transamazonica road, (Maraba-Altamira), near R. Anapu; 8.iv.1976, B.M.1979-580 (*W.Arouck*) – several ♀ ♀ (man-biting) (BMNH). Amazonia Nacional Park; 1.ix.1978, B.M.1979-580 (*L.A.Lacey*) – 5 ♀ ♀ (man-biting) (BMNH).

SLIDE

Near Altamira, Laranjal, R. Iriri, Indian camp by riverside, 52°53'W 3°50'S; 1.iii.1984, vii.1984, (*T.Harvey*) – 16 ♀ ♀ (man-biting) 1 ♂ (reared) (BMNH). Km 360, Transamazonica road (Maraba-Altamira), near R. Anapu; 8.iv.1976, B.M.1979-580 (*W.Arouck*) – 1 ♀ (man-biting) (BMNH). Uruá, R. Tapajós, 56°19'W 4°33'S; 29.viii.1979, 1.ix.1978, B.M.1979-580 (*L.A.Lacey*) – 2 ♀ ♀ (man-biting) (BMNH).

Rio de Janeiro State

SPIRIT

Fregesia, road from Araticum; 9.v.1978, B.M.1979-580

(*M.Aragão & A.P.A.Luna Dias*) – 13 ♀♀ (man-biting) (BMNH).

Roraima State

PINNED

Mission post, R. Auaris; 7.vii.1976, 29.iii.-1.iv.1977, B.M.1979-580 (*R.R.Pinger*) & 8.xii.1986 (*A.J.Shelley & A.P.A.Luna Dias*) – 18 ♀♀ (man-biting) (BMNH). Surucucus, Dalem; 11.xii.1986 (*A.J.Shelley & A.P.A.Luna Dias*) – 1 ♀ (man-biting) (BMNH). R. Mucajaí, 200m below Igarapé Coroconá; 21.vii.1984, (*A.J.Shelley & A.P.A.Luna Dias*) – 3 ♀♀ 5 ♂♂ (reared) (BMNH). Mission, R. Mucajaí; 5.i.1977, B.M.1979-580 (*A.J.Shelley*) – 9 ♀♀ 11 ♂♂ (reared) (BMNH). Catrimani mission, R. Catrimani; 9.i.1977, B.M.1979-580 (*A.J.Shelley*) – 1 ♀ 1 ♂ (reared) (BMNH). Catrimani mission, R. Catrimani; 13.i.1979, B.M.1979-580 (*A.J.Shelley & A.P.A.Luna Dias*) – 1 ♀ (reared) (BMNH). R. Uraricoeira; 20.i.1979, B.M.1979-580 (*A.J.Shelley & A.P.A.Luna Dias*) – 2 ♂♂ (reared) (BMNH). Vila Pereira, R. Surumu; 25.xi.1980 (*A.J.Shelley*) – 3 ♀♀ 2 ♂♂ (reared) (BMNH). Near Normandia, Fazenda Guanabara, R. Maú; 2.xii.1980, (*A.J.Shelley*) – 1 ♂ (reared) (BMNH).

SPIRIT

Mission post, R. Auaris; 29.iii. - 4.iv.1977, (*R.R.Pinger*) & 8.xii.1986, (*A.J.Shelley & A.P.A.Luna Dias*) – numerous ♀♀ (man-biting) (BMNH). R. Mucajaí, mission post; 5.i.1977, B.M.1979-580 (*A.J.Shelley & A.P.A.Luna Dias*) – 4 ♀♀ 13 ♂♂ (reared), 8 pupae (BMNH). Mucajaí; 5.i.1977, B.M.1979-580 (*A.J.Shelley*) – 1 pupa (BMNH). R. Mucajaí, 200m below Igarapé Coroconá; 21.vii.1984, (*A.J.Shelley & A.P.A.Luna Dias*) – 1 ♀ 5 ♂♂ (reared), numerous pupae (BMNH). Mucajaí, Igarapé downriver from Coroconá; 6.i.1977, B.M.1979-580 (*A.J.Shelley*) – 1 ♀ (mass reared), numerous pupae (BMNH). Northern Perimeter road, Catrimani mission, R. Catrimani; 9.i.1977, B.M.1979-580 (*A.J.Shelley*) & 12.i.1979, B.M.1979-580 (*A.J.Shelley & A.P.A.Luna Dias*) & 9.i.1977, B.M.1979-580 (*A.J.Shelley*) – 2 ♀♀ 5 ♂♂ (reared), 17 pupae, 3 pupal exuviae (BMNH). Near Normandia, Fazenda Guanabara, R. Maú; 2.xii.1980 (*A.J.Shelley*) – 1 pupal exuviae (BMNH). Cachoeira Bem Querer, R. Branco; 16.i.1979, B.M.1979-580 (*A.J.Shelley & A.P.A. Luna Dias*) – 2 ♂♂ (reared) (BMNH). Cachoeira Bem Querer, near Caracará, R. Branco; 16.i.1979, B.M.1979-580 (*A.J.Shelley & A.P.A. Luna Dias*) – 1 pupal exuviae (BMNH). R. Uraricoeira; 20.i.1979, B.M.1979-580 (*A.J.Shelley & A.P.A. Luna Dias*) – 2 ♀♀ 2 ♂♂ (reared), 2 pupae, (BMNH). Vila Pereira, R. Surumu; 25.xi.1980 (*A.J.Shelley*) – 3 ♀♀ 9 ♂♂ (reared), numerous pupae (BMNH). Serra dos Surucucus, FUNAI Post; 6.v.1982 (*A.P.A.Luna Dias & R.Malaguti*) – 1 ♀ (BMNH). Surucucus, Igarapé in front of FUNAI; 9.xii.1986 (*A.J.Shelley & A.P.A. Luna Dias*) – 2 ♀♀ (man-biting) (BMNH). 10km north of junction of Boa Vista-Sta. Elena-Surumu road, waterfall; 11.viii.1984, (*A.J.Shelley & A.P.A.Luna Dias*) – 2 ♀♀ (BMNH). 14km from junction Vila Pereira road, Boa Vista to Sta. Elena road, rapids on R. Surumu; 11.viii.1984, (*A.J.Shelley & A.P.A.Luna Dias*) – 1 pupa (BMNH).

SLIDE

Mission post, R. Auaris; 29.iii-4.iv.1977, (*R.R.Pinger*) – 5 ♀♀ (man-biting) (BMNH, IOC). Mucajaí mission post; 5.i.1977,

B.M.1979-580 (*A.J.Shelley*) – 4 ♀♀ 1 ♂ (reared) (BMNH, IOC). R. Mucajaí, 200m below Igarapé Coroconá; 21.vii.1984, (*A.J.Shelley & A.P.A.Luna Dias*) – 3 ♀♀ 2 ♂♂ (reared) (BMNH, IOC). Catrimani mission, R. Catrimani; 12.i.1979, B.M.1979-580 (*A.J.Shelley & A.P.A.Luna Dias*) – 2 ♂♂ (reared) (BMNH).

São Paulo State

PINNED

Fazenda Santa Cruz, Rio Pardo (site 889); 30.viii.1992, (*A.J.Shelley*) – 4 ♀♀ 7 ♂♂ (reared) (BMNH). Cornelio Procopio to Ourinhos Road Km 20 near Ourinhos (site 884), Rio Laranjinha; 29.viii.1992, (*A.J.Shelley*) – 1 ♀ 1 ♂ (reared) (BMNH). Bandeirantes-Ourinhos-Cambará road, 15km from Bandeirantes, Rio das Cinzas (site 885); 29.viii.1992, (*A.J.Shelley*) – 1 ♀ (reared) (BMNH).

Simulium (Trichodagmia) nigrimanum Macquart

BRAZIL

Goiás State

PINNED

Road DF2a, R. Palmeiras, Córrego Sonhem; 5.iv.1976, (*A.J.Shelley*) – 1 ♀ 1 ♂ (reared) (BMNH). Formosa-Itiquira Road, Córrego Bandeirinha; 26.ix.1975, (*A.J.Shelley*) – 1 ♀ 1 ♂ (reared) (BMNH). Km 15, Estrada Niquelandia-Dois Irmãos, R. Bagaginho; 4.vi.1976, (*A.J.Shelley*) – 1 ♀ 1 ♂ (reared) (BMNH). Minaçu area, Córrego Grande (site 765); 9.vii.1986, (*A.J.Shelley & A.P.A.Luna Dias*) – 1 ♀ 1 ♂ (reared) (BMNH). Cachoeira da Areia (site 758); 7.vii.1986, (*A.J.Shelley & A.P.A.Luna Dias*) – 1 ♀ (man-biting) (BMNH). Fazenda Espigão (site 749), Rio Bonito; 4.vii.1986, (*A.J.Shelley & A.P.A.Luna Dias*) – 3 ♀♀ (man-biting) (BMNH). Fazenda Santa Ruth (site 1), Rio Bonito; 27.ix.1995, (*Percil*) – 3 ♀♀ (man-biting) (BMNH). Rio Bonito (bridge) (site 742); 3.vii.1986, (*A.J.Shelley & A.P.A.Luna Dias*) – 2 ♀♀ (reared) (BMNH). Chacara Sta Ruth, bridge, Rio Bonito (site 739); 2.vii.1986, (*A.J.Shelley & A.P.A.Luna Dias*) – 1 ♀ (man-biting) (BMNH). Fazenda Sta Ruth (site 1), Rio Bonito; 27.ix.1995, (*Percil*) – 1 ♀ (man-biting) (BMNH). Fortaleza (site 2), Rio Tocantins; 26.iv.1995, (*Percil*), 2.iv.1996, (*Percil*), 26.ix.1995, (*M.Elias*), 28.iv.1995 (*Percil*) – 3 ♀♀ (man-biting), 1 ♂ (reared) (BMNH). Rio Tocantins (as Maranhão) (site 767); 9.vii.1986 (*A.J.Shelley & A.P.A.Luna Dias*) – 1 ♀ (man-biting) (BMNH). Fazenda São Jose I., Rio Mucambão (site 3); 30.ix.1996, (*Percil*) – 1 ♀ (man-biting) (BMNH). Minaçu-Palmeiropolis Road, Rio Mucambão (site 9); 12.x.1991, (*A.J.Shelley*) – 1 ♂ (reared) (BMNH). Santo Antonio de Cana Brava (site 4), Rio Cana Brava; 23.vii.1995, (*Percil*) – 1 ♂ (reared) (BMNH).

SPIRIT

Minaçu area, Cachoeira da Areia; 8.vii.1986, (*A.J.Shelley & A.P.A. Luna Dias*) – 2 pupae (BMNH). Goiás/Tocantins border, Rio Mucambão (below bridge); 30.v.1992, (*C.Lowry & A.P.A.Luna Dias*) – 4 ♀♀ 8 ♂♂ (reared), numerous pupae (BMNH). Fazenda Santo Antonio, Rio Mucambão; 1.vi.1992,

(*C.Lowry & A.P.A.Luna Dias*) – 1 ♀ (reared) (BMNH). Rio Mucambão; vii. & viii.1995, (*M.Camargo*) – numerous ♀ ♀ (man-biting) (BMNH). Ribeirão Bonito; 26.v.1992, (*C.Lowry & A.P.A.Luna Dias*) – 15 ♀ ♀ (man-biting) (BMNH). Ribeirão Bonito; 26.v.1992, (*C.Lowry & A.P.A.Luna Dias*) – 5 ♀ ♀ 4 ♂ ♂ (reared), 12 pupae (BMNH). R. Bonito; iii.1995, (*M.Camargo*) – 1 ♀ (man-biting) (BMNH). R. Bonito; vi.1995, (*M.Camargo*) – 15 ♀ ♀ (man-biting) (BMNH). R. Bonito; vii.1995, (*M.Camargo*) – numerous ♀ ♀ (man-biting) (BMNH). Fazenda Margem Esquerda, Rio Cana Brava; 28.v.1992, (*C.Lowry & A.P.A.Luna Dias*) – 2 ♀ ♀ 1 ♂ (reared), 2 pupae (BMNH). Fazenda Margem Esquerda, Rio Cana Brava; 2.vi.1992, (*C.Lowry & A.P.A.Luna Dias*) – 3 pupae (BMNH). Santo Antonio da Cana Brava, Rio Cana Brava; vi.1992, (*C.Lowry & A.P.A.Luna Dias*) – 4 pupae (BMNH). Santo Antonio da Cana Brava, Rio Cana Brava; 1.vi.1992, (*C.Lowry & A.P.A.Luna Dias*) – 1 ♂ (reared) (BMNH). Santo Antonio da Cana Brava, Rio Cana Brava; 27.v.1992, (*C.Lowry & A.P.A.Luna Dias*) – 3 pupae (BMNH). R. Tocantins-Fortaleza; vi.1995, (*M.Camargo*) – 1 ♀ (man-biting) (BMNH).

SLIDE

Minaçu area, Ribeirão Bonito; 26.v.1992, 2.vi.1992, iii.viii.1995, (*M.Carmargo, C.Lowry & A.P.A.Luna Dias*) – 1 ♀ (reared), 5 ♀ ♀ (man-biting), 1 ♂ (reared) (BMNH). Rio Tocantins, UNDP Project; 28.ix.1995,

(*M.Carmargo*) – 1 ♂ (reared) (BMNH). BR 153 Belém-Brasília Highway, Km 35 from Anapolis, Rio Padre Souza; 26.v.1976, (*A.J.Shelley*) – 1 ♀ (reared) (BMNH). BR 153 Belém-Brasília Highway, Km 187 from Anapolis, Rio São Patricio; 27.v.1976, (*A.J.Shelley*) – 1 ♀ (reared) (BMNH).

Federal District

PINNED

Descoberto dam, outlet stream; 8.vi.1976, (*A.J.Shelley*) – 8 ♀ ♀ 8 ♂ ♂ (reared) (BMNH).

Minas Gerais State

PINNED

28.ix.1903, (*A.Lutz*) – 1 ♀ (IOC).

COLOMBIA

PINNED

Mitú; viii.1967 (*C.J.Marinkelle*) – 4 ♀ ♀ (man biting) (BMNH).

SPIRIT

Mitú; viii.1967 (*C.J.Marinkelle*) – numerous ♀ ♀ (man biting) (BMNH).

SLIDE

Mitú; viii.1967 (*C.J.Marinkelle*) – 1 ♀ (man biting) (BMNH).

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