

Black flies (Diptera: Simuliidae) of the Marquesas Islands, French Polynesia: redescriptions and new species

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Abstract: All stages of *Simulium buissoni* Roubaud, 1906 are redescribed. Larvae, pupae, and males of *S. gallinum* Edwards, 1932 are associated with the female holotype and all are fully described. *Simulium adamsoni* Edwards, 1932, the males of which have enlarged cerci, gonocoxae fused medially, and an enlarged keel-like ventral plate, is similarly redescribed. The female holotype and two paratypes of *S. mumfordi* Edwards, 1932 are fully redescribed. Males and females of *S. hukaense* Séchan, 1983 are associated with the pupae and larvae and described. Since all type material of this species is lost, a neotype is designated. *Simulium uaense* Séchan, 1983 is briefly mentioned. Three new species are described: *S. pichoni* Craig, Fossati, and Séchan, *S. rivierei* Craig, Fossati, and Séchan, and *S. sechani* Craig and Fossati. Brief comments are made concerning the bionomics and the relationships of the species.

Résumé : On trouvera ici une nouvelle description de tous les stades de *Simulium buissoni* Roubaud, 1906. Des larves, nymphes et mâles de *S. gallinum* Edwards, 1932 ont été associés à l'holotype femelle et on peut en lire ici la description. Il en va de même pour *S. adamsoni* Edwards, 1932 dont les mâles, aux cerques renflés et aux gonocoxas fusionnées en leur milieu, possèdent une grande plaque ventrale carénée. L'holotype femelle et deux paratypes de *S. mumfordi* Edwards, 1932 font l'objet de descriptions entièrement nouvelles. Des mâles et des femelles de *S. hukaense* Séchan, 1983 ont été associés aux nymphes et aux larves et ils sont décrits ici; tout le matériel type de cette espèce a été perdu et il a donc fallu désigner un néotype. *Simulium uaense* Séchan, 1983 est mentionné. Trois nouvelles espèces sont décrites : *S. pichoni* Craig, Fossati et Séchan, *S. rivierei* Craig, Fossati et Séchan et *S. sechani* Craig et Fossati. La dynamique des populations et les relations interspécifiques font l'objet de brefs commentaires.

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Introduction

The Marquesas Islands are located some 1500 km northeast of the Society Islands and are noted for their natural beauty. Like Tahiti (Loti 1887), the Marquesas have their associated romantic literature (see review by Lavondes and Pichon 1972). Most such literature describes these Polynesian Islands as paradise, but even paradise has its darker side.

The Simuliidae of the Marquesas Islands have been of interest since well before Roubaud (1906) described *Simulium buissoni*, because this species, known locally as the "nono," or "nono noir" to distinguish it from mosquitoes, is seriously anthropophilic and ornithophilic. Melville (1847) commented bitterly about the problems of biting flies on Nuku Hiva, and Edwards (1932) and Cheesman (1932) gave graphic accounts of the problems caused by *S. buissoni*, noting that the females would even fly out to sea and bite people

on incoming boats. Edwards referred to this simuliid as the "scourge" of the Marquesas.

Such biting was serious enough for the Marquesans to incorporate the nono into their pictographs, which represent the insects as having trident mouthparts (Lavondes and Pichon 1972). However, it should be noted that the term nono is used indiscriminately for all biting insects.

Edwards (1932) redescribed females of *S. buissoni* and gave descriptions of the immature stages. He also described females of *S. adamsoni*, *S. buissoni gallinum*, and *S. mumfordi*. He further noted that Adamson had written to him that *S. buissoni* had apparently disappeared, or had ceased to bite humans, in Ua Pou late in the 1800s.

Lavondes and Pichon (1972) discussed this apparent disappearance, known locally as the "miracle of the nono," and attempted to relate it to the distribution of the then known species. They noted that there were older myths referring to the disappearance of the nono in the more southerly Marquesas Islands.

Rothfels (Craig 1983; Rothfels 1989) showed that the Polynesian species are unique among the Simuliidae because the females are heterogametic. He also showed that *Simulium teruamanga* of Rarotonga is related to a Marquesan simuliid; unfortunately, it is not known which one, but it was most likely *S. buissoni*. More recent attempts at chromosomal

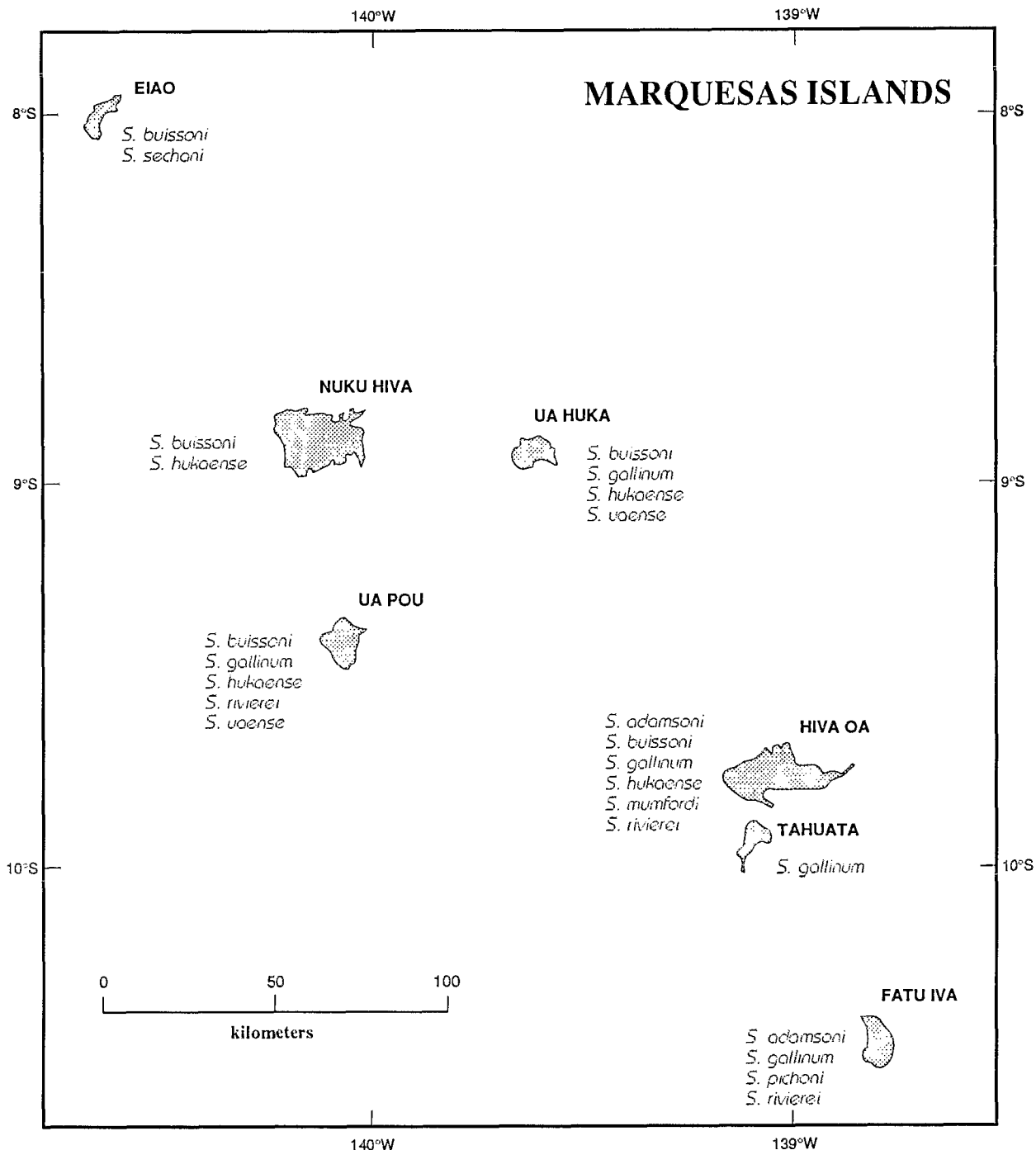
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Fig. 1. Map of the Marquesas Islands, showing the distribution of species of Simuliidae. Based on this work, Klein et al. (1983), and Edwards (1932). The smaller islands have been omitted.



analysis of Polynesian simuliids from collections by Craig and by Séchan have not been successful.

Séchan (Klein et al. 1983) collated the then known material from the Marquesas, raised *S. b. gallinum* to full specific status, and provided further details of the immature stages of *S. buissoni*. He also described *S. hukaense* and *S. vaense*, using mainly pupal characters and some from the larvae and noted that there appeared to be other species. The distribution of presently known Marquesan simuliids is given in Fig. 1.

Crosskey (1988) placed all the then known Marquesan

species in the subgenus *Inseliellum*, for which Craig (1987) provided a detailed diagnosis.

Under the auspices of the Institut Francais pour la Recherche et le Développement en Coopération (ORSTOM) and the Institut Territorial de Recherches Médicales Louis Malardé (ITRMLM), an attempt was made during January to April 1993 to eradicate *S. buissoni* from Nuku Hiva. Temephos (AbateTM) was added to all flowing rivers every 2 weeks. After the first two applications of insecticide, populations of biting females were reduced to 4% of previous levels. However, heavy rain in March 1993 precluded fur-

ther reductions of the populations. By October 1993, populations of *S. buissoni* had increased to pretreatment densities (Fossati and Séchan 1993; Séchan et al. 1993).

The above attempt at eradication was the main impetus for this taxonomic work.

Methods

Material available for this study was highly variable in condition. As usual with older pinned adult simuliids from Polynesia (Craig 1987), the pinned material from the Marquesas Islands was badly collapsed and generally of little taxonomic use. The larvae also were highly variable in condition, having been preserved in a variety of fixatives, some of which had bleached the specimens. Luckily, there were more recent collections and in some instances good series of reared adults.

Where necessary, pinned adults were depinned, humidified, and soaked in distilled water and Prell™ detergent to degrease them, shellac was removed in absolute ethanol and lacquer thinner if required, then they were critical-point dried and repinned. Genitalia were prepared by warming the whole adult for a short time in 10% KOH, then in distilled water, which caused the body to expand. When the genitalia were fully distended, the body was punctured to release the pressure and the specimen returned to the KOH to complete clearing. Observations and drawings were made with the genitalia attached to a smear of Vaseline™ in a depression slide and covered with glycerine.

To produce pinned specimens from adults in liquid preservative, adults were transferred to absolute ethanol, critical-point dried, and pinned. This technique produced superior specimens but the colours were slightly muted. Some adults were dried via the Peldri™ (Ted Pella Inc., Redding, California) technique (Sims 1991), which preserved the colours better.

Larvae were dissected in 80% ethanol and structures required for examination mounted directly into polyvinyl lactophenol (Gurr, High Wycombe, Bucks., England).

As with Simuliidae from the Society Islands (Craig 1987), association of the stages of the various species from the Marquesas Islands was difficult. Unfortunately, in no material was the ecdysed larval cuticle attached to the pupa and associated to a reared adult. Consequently, association of stages has often been made simply on the basis that larvae,

pupae, and adults occurred in the same collection. However, as usual with Simuliidae, it is possible to dissect the pharate pupal gill and associate mature last-instar larvae to pupae. This was done whenever possible. For each species, comments are made regarding the status of association of stages.

Most of the material examined is in the collection of the Unité de Lutte Contre les Vecteurs, ITRMLM, B.P. 30, Papeete, Tahiti, Polynésie Française, but new types and representative material have been deposited in other institutes.

Names of other institutions where material is deposited are abbreviated as follows:

BMNH	Department of Entomology, Natural History Museum, Cromwell Road, London, SW7 5BD, England.
BPBM	Bernice P. Bishop Museum, P.B. 19000-A, Honolulu, HI 96819, U.S.A.
CNCI	Canadian National Collection of Insects, Arachnids and Nematodes, Biological Research Division, Centre for Land and Biological Resources Research, Agriculture Canada, Ottawa, ON K1A 0C6, Canada.
DAC	Personal collection (D.A. Craig, Department of Biological Sciences, University of Alberta, Edmonton, AB T6G 2E9, Canada).
MNHP	Department d'Entomologie, Muséum National d'Histoire Naturelle, 45 rue de Buffon, 75005, Paris, France.
NZAC	New Zealand Arthropod Collection, Landcare Research, New Zealand, Ltd., P.B. 92170, Auckland, New Zealand.
ORSTOM	Centre ORSTOM, de Montpellier, 911 avenue d'Agropolis, 34032, Montpellier, Cédex 1, France.

There is a great deal of variation in the spelling of Polynesian place names. Where possible, those from the Atlas de la Polynésie Française (ORSTOM 1993) are used.

Label data are reported in the same manner as for Craig (1987); material from each label is indicated by quotation marks and lines on the label are delimited by a slash mark. Likewise, the morphological terms of Craig (1987) are used.

A preliminary data base (Macintosh, "FileMaker Pro 2.0™," Claris) for localities of most of this material and that of other Polynesian Simuliidae is available from the senior author.

Taxonomic treatment

Keys to adults of Simuliidae from the Marquesas Islands

Description of colours is based on material in alcohol. Use of these keys requires preparation of the genitalia.

Females

Females of *S. sechani* and *S. uaense* are unknown.

1. Black-brown. Appendages distinctly yellowish2
Light to dark brown. Appendages not distinctly yellowish3
2. Wing length greater than 1.9 mm. Genitalia as in Fig. 2*S. adamsoni*
Wing length less than 1.8 mm. Genitalia as in Fig. 6*S. numfordi*
3. Scutellum distinctly pale.....*S. pichoni* n.sp.
Scutellum brown4

4. Mouthparts 0.6 times head depth or greater; mandibular articulations substantial *S. buissoni*
 Mouthparts 0.5 times head depth or less; mandibular articulations less substantial 5
5. Dark to very dark brown. Thorax almost as wide as long 6
 Lighter brown. Thorax distinctly longer than wide *S. rivierei* n.sp.
6. Distinct medial flange on arm of genital fork (Fig. 4) *S. gallinum*
 Medial flange absent (Fig. 8) *S. hukaense*

Males

Males of *S. mumfordi*, *S. sechani*, and *S. uaense* are unknown.

1. Body length 3.0 mm. Brownish black. Ventral plate keel-like. Cerci very large (Fig. 9) *S. adamsoni*
 Body length less than 1.9 mm. Dark to light brown. Ventral plate and cerci essentially normal 2
2. Scutellum distinctly pale *S. pichoni* n.sp.
 Scutellum brown 3
3. Ventral plate with lateral flange (Fig. 12) *S. hukaense*
 Ventral plate without flange (e.g., Fig. 10) 4
4. Ventral plate wider than deep, anterior edge concave (Fig. 14) *S. rivierei* n.sp.
 Ventral plate deeper than wide, anterior edge convex (Figs. 10, 11) 5
5. Anteromedian notch of ventral plate substantial (Fig. 11) *S. gallinum*
 Anteromedian notch of ventral plate insubstantial (Fig. 10) *S. buissoni*

Key to pupae of Simuliidae from the Marquesas Islands

Pupae of *S. mumfordi*, *S. pichoni*, *S. rivierei*, and *S. sechani* are unknown.

1. Four gill filaments (Fig. 17) *S. gallinum*
 More than four gill filaments 2
2. Five gill filaments *Simulium* sp. 1*
 More than five gill filaments 3
3. Six gill filaments (Fig. 16) *S. buissoni*
 More than six gill filaments 4
4. Seven gill filaments 5
 More than seven gill filaments 6
5. Three dorsal filaments not arising from single position (Fig. 18) *S. hukaense*
 Three dorsal filaments arising from single position (Fig. 19) *S. uaense*
6. Eight gill filaments *Simulium* sp. 2*
 Ten gill filaments (Fig. 15) *S. adamsoni*

Key to mature larvae of Simuliidae from the Marquesas Islands

Larvae of *S. mumfordi*, *S. pichoni*, *S. rivierei*, and *S. uaense* are unknown.

1. Larger (length 5.0–6.0 mm). Body dark brown overall. Head spots positive; hypostoma with 20 teeth; antenna shorter than fan stem (Figs. 20, 28) *S. adamsoni*
 Smaller (length 3.8–4.6 mm). Lighter brown. Head spots negative; hypostoma with 13 teeth; antenna longer than fan stem 2
2. Head brown to pale, postgenal cleft squarish (Figs. 21, 22, 23). 25–34 labral fan rays 3
 Head very pale. Postgenal cleft pointed (Fig. 24). 19–23 labral fan rays *S. sechani* n.sp.
3. Head darker brown, spots distinct. Postgenal cleft narrowed anteriorly, often with median projection (Fig. 21) *S. buissoni*
 Head spots less distinct. Postgenal cleft squarish anteriorly 4
4. Head lighter, anteromedian head spots indistinct (Fig. 22) *S. gallinum*
 Head slightly darker, anteromedian head spots distinct (Fig. 23) *S. hukaense*

*See Incertae sedis.

Simulium (Inseliellum) adamsoni Edwards
Figs. 2, 9, 15, 20, 25, 26, 28, 33, 34

Simulium adamsoni Edwards, 1932: 109.

Simulium adamsoni Edwards. Klein, Rivière, and Séchan 1983: 63–64.

Simulium (Inseliellum) adamsoni Edwards. Crosskey 1988: 453; 1989: 224. Crosskey and Lowry 1990: 202.

Holotype

Female: pinned. Label data: "Atuona Valley/ HivaOa 330 ft/iii-28-1929", "Marquesas/Islands", "Mumford & / Adamson", "over river", "Pacific Entomological Survey", "Type (red circled)", "S. adamsoni/ Edw/F.W. Edwards./ det. 1931", "Simulium adamsoni/ Edwards/ Holotype/No. 587 (red)" (BPBM).

Diagnosis

Female: overall black–brown, appendages yellow. Cerci triangular with distal tuft of hair. Spermatheca with pigment extended into duct. Male: similar in colour to female. Genitalia unique; ventral plate extended posteroventrally as massive keel-like structure, gonostyli short, gonocoxa fused medially with sternite IX, cerci massive and articulated dorsolaterally to tergite IX. Pupa: 10 gill filaments; sharp thoracic tubercles. Cocoon of coarse weave and distinct anterior margin, lateral walls not flared. Larva: overall dark brown; hypostoma with 20 teeth.

Association of all stages of *S. adamsoni* is firm. The holotype was found to be in excellent condition, which allowed definitive association with reared females and their associated pupal exuviae. There was an excellent series of reared males, fully developed pupae, and mature last-instar larvae.

Description

Adult female

Body: overall blackish brown; length 1.3–2.9 mm; appendages yellowish. Head: evenly dark brown in colour, width 0.79 mm, depth 0.56 mm. Eyes: interocular distance 0.16 mm; frontal angle 96°; ommatidia 0.014 mm in diameter, approximately 26 and 50 across and up eye, respectively. Frons: slightly darker than scutum. Clypeus: 0.2 times as wide as head width, lighter in colour than frons, pale distally, with dense vestiture of fine yellow hairs, apex only slightly cone-shaped. Postocular hairs dense, short, yellow. Antenna: length 0.47 mm; scape, pedicel, and proximal flagellomeres yellow, remainder slightly darker. Mouthparts: length 0.4 times head depth; mandibles with 18 teeth; laciniae with 21 retrorse teeth, the 7 medial teeth very substantial; palpus 0.63 mm long, distal article as long as remainder of palpus, sensory vesicle occupying 0.3 times width of third article, opening 0.5 times width of vesicle, ca. 14 sensillar sockets visible, third article with sharply angled anteromedial margin, 1–3 substantial hairs on angle extended to 0.5 times length of next article. Cibarial pump: proximal arms substantial, heavily pigmented, space between smooth and deeply U-shaped, as wide as deep. Thorax: length 0.99–1.22 mm, width 0.85–0.95 mm, pronotum densely covered in long yellow hairs; postpronotum brown,

but lighter than scutum, vestiture of dense, fine yellow hairs; scutum, evenly dark brown, vestiture of fine yellow hairs, anterolateral margins darker than postpronotal lobes; scutellum slightly paler than scutum, apical angle 118°, posterolateral edges straight, vestiture of small dark hairs with coarse black hairs posteriorly; postscutellum concolorous with scutellum; pleuron evenly light brown. Wing: length 1.9–2.5 mm, maximum width 0.75–0.87 mm; veins pale; stem vein hair tuft consists of short hairs arrayed along vein. Halter: knob pale, concolorous with pedicel. Legs: mainly yellowish brown; forelegs and midlegs distinctly so; trochanter of midlegs and hind legs with vestiture of coarse yellow hair; hind femur yellow with distal 1/8 brown, tibia all brown, first tarsomere yellow with distal 1/8 brown; pedisulcus on second tarsomere pale and deeply incised. Pretarsal claw with basal tooth 0.3 times length of claw, forming 9° angle with claw tip, inner margin of claw evenly curved. Abdomen: generally mottled brown with vestiture of fine yellow hairs, segment I very pale; basal fringe of hairs extended only to first abdominal segment; tergite II yellowish and 3 times wider than long; tergites III–VI decreasing in size until width equal to length; tergites VII and VIII not obvious, but terga subshiny; sternum generally mottled brown; sternite I very pale, sternites II–V mottled brown, sternite VI darker, sternites VII and VIII dark brown with vestiture of fine silvery and dark hairs, longer on sternum VII. Genitalia (Fig. 2): heavily pigmented; sternite VIII dark, lighter medially; cercus brown laterally, paler medially, triangular in lateral view with concave dorsal margin, subapical tuft of hair (at lower magnifications, hairs appear as a spine); anal lobe extending to 0.2 times length of cercus; hypogynial valves brown proximally, paler distally, broadly rounded apically, vestiture of sparse, coarse, short black hairs laterally, distolaterally of grouped microtrichia in regular array; width of median space greatest at 0.3 times depth, extended to branch of genital fork, evenly rounded anteriorly; stem of genital fork robust, lateral arms wide with anterolateral portion curved and flared. Spermatheca ovoid, evenly very dark brown, pigment extended for short distance along duct.

Adult male

Body: generally dark brownish black; length 3.1 mm. Head: width 0.79 mm, depth 0.63 mm. Eyes: upper ommatidia 0.03 mm in diameter, ca. 31 and 34 rows up and across eye, respectively; lower ommatidia 0.014 mm in diameter, ca. 13 and 15 rows up and across eye, respectively, division between upper and lower ommatidia not distinct except for colour. Clypeus: 0.2 times as wide as head. Antenna: length 0.41 mm, scape and pedicel slightly darker than yellowish flagellum. Mouthparts: length 0.28 times head depth; mandibles not observed, probably absent; laciniae finely tapered with apical hairs; palpus 0.51 mm long, distal article 0.21 mm long, width of sensory vesicle 0.3 times width of article, width of opening 0.33 times width of vesicle, ca. four sensillar sockets visible. Thorax: length 1.17 mm, width 0.75 mm; postpronotal lobes and scutum brownish black, vestiture of scutum of sparse golden hairs; scutellum slightly paler, apical angle 140°, vestiture of essentially a single row of long coarse black hairs. Wing: length 1.6 mm, maximum

width 0.63 mm, stem vein hair tuft substantial. Halter: knob and pedicel pale. Legs: forelegs brown; mid and hind legs mainly yellow; coxae of hind leg with distal tuft of yellow hairs. Pretarsal claw with ca. 37 grappling hooks dorsally (Fig. 26). Abdomen: brownish black; basal fringe of long yellow hairs extending to second abdominal segment; tergites brownish black, posterior ones subshiny, vestiture of sparse yellow hairs; sternites wider than long, posterior ones increasing in width. Genitalia (Figs. 9, 25): heavily pigmented; partially inserted into abdomen and directed ventrally; gonocoxae as long as wide, massive, fused medially to each other and to sclerotized posterior edge of sternite IX, essentially forming a "genital capsule," posteromedial lobe with dense vestiture of coarse black hairs; gonostylus approximately 0.5 times as wide as long, tapering rapidly, coadapted ventrally to fit dorsally over ventral plate (Fig. 25), single large blunt terminal spine; ventral plate massive and keel-like, directed posteroventrally, proximal arms massive, space between smoothly U-shaped; flanged laterally, bulbous apically. Cerci: massive, extended posteriorly beyond genitalia, finely tapered, articulate basally with tergite IX, vestiture of fine hairs.

Pupa

Length: male 2.3–2.6 mm, female 2.0–2.5 mm. Gill (Fig. 15): length 1.2 mm, 10 filaments (2+3+3+2), occasionally 9 and (or) 11 on the same specimen (if 11, usually as a short branch on dorsalmost filament pair). Thorax: cuticle pale yellow; sparse sharply cone-shaped black tubercles. Abdomen: sternite III bare; sternite IV with 2 bifurcated spines, cuticle with small tubercles, sternite V as for IV, but with 4 bifurcated spines medially, sternite VI as for V, but spines widely spread, sternite VII with 4 trichoid spines placed laterally; tergite I bare, tergite II with 8 small spines, tergites III and IV with 8 substantial spines, tergite V bare, tergite VI with 4 insubstantial spines, tergite VII with 6–8 posteriorly directed spines, tergite VIII with 16–18 spines, tergite IX with many small spines: terminal spines directed posteriorly, not sinuous laterally, rounded apically. Cocoon: coarsely woven, distinct anterior margin, walls not flared laterally.

Larva

Last instar with dark pharate pupal gills: length 5.0–6.0 mm. Body: evenly grayish brown. Head (Fig. 20): width 0.82 mm, length 0.76 mm: distance between fan stem bases 0.40 mm: generally dark brown; frontoclypeal apotome slightly paler, head spots indistinct, median spots positive, others slightly negative: cuticle slightly rugose and corrugated; apotome distinctly hairy anteriorly; lateral margins strongly convex posteriorly; cervical sclerites small, distinct, and fused to postoccipt. Antenna: shorter than labral fan stem: distal article 0.09 mm: proximal and distal articles brown; median article lighter proximally. Labral fans: stem brown, distinctly constricted laterally at junction with head; 25–28 rays ca. 0.55 mm in length; rays dark brown; 10 or 11 posterolateral rays less substantial than others; microtrichia of medial rays 0.33–0.50 times as long as ray width; pattern of longer microtrichia with 7 or 8 smaller ones decreasing slightly in size to next long one; pattern indistinct. Hypostoma (Fig. 28): 20 teeth, median tooth prominent;

3 shorter sublateral teeth increasing in size to more prominent lateral tooth; 6 paralateral teeth directed medially (teeth often show considerable wear and damage); two to four lateral serrations; five or six hypostomal setae per side; in penultimate-instar larvae the median tooth and adjacent sublateral teeth protrude from the general line of the remaining teeth. Postgenal cleft: shaped like a shallow inverted V; postgenal bridge 3 times longer than cleft depth, concolorous with head. Head setae: numerous with slightly raised sockets. Mandible (Fig. 34): tooth posterior to apical tooth slightly more than 0.5 times length of apical tooth; then 2 substantial teeth: ca. 12 spinous teeth; essentially no space between spinous teeth and serration; serration substantial and continued proximally into convex bladeflake flange (often showing damage); one or two sensilla (variable even on same specimen), posterior sensillum larger, 0.4 times length of serration. Maxillary palpus: 4.0 times as long as basal width, evenly dark brown. Mandibular phragma: extended ventrally to essentially full depth of maxilla base. Prothoracic proleg: dorsolateral sclerite heavily pigmented, interrupted dorsally, extended fully ventrally around apex of distal article (Fig. 33). Abdomen: segments I–IV increase slightly in size posteriorly, expanding rapidly at segment V and slightly to segment VII, then decrease evenly; colour extended completely around segments I–IV; sterna of remaining segments pale; posteroventral tubercles small but distinct; posterodorsal cuticle smooth with simple trichoid sensilla. Anal sclerite: posteroventral arms 1.3 times as long as dorsolateral arms, not fused to simple lateral accessory sclerites (often of one larger dorsal sclerite and one or two smaller ventral sclerites). Cirlet of hooks: 94–96 rows of hooks, 14–16 hooks per row. Anal papillae: simple.

Bionomics

Simulium adamsoni belongs to the *oviceps*-group (Craig 1987), as indicated by larval characteristics such as tooth number and shape of the hypostoma, general darker colouration of the body, and head shape and fan rays. Like those of many other species of that taxon, larvae of *S. adamsoni* are found at higher altitudes and in faster water. They probably browse extensively, because damage to the hypostomal and mandibular teeth was common. This was further substantiated by gut contents that showed a high proportion of small volcanic glass particles and large filamentous algae. The pupae were on roots and grass. *Simulium adamsoni* occurs sympatrically with *S. gallinum* in Tahauku Cascade, Hiva Oa.

The mating behaviour of *S. adamsoni* might be unusual because the male has more grappling hooks on the pretarsal claws (Fig. 26) than other Polynesian male simuliids. More hooks may be needed to hold the female securely while the male engages his substantial genitalia.

Comments

The larva of *S. adamsoni* clearly places this species in the *oviceps*-group (Craig 1987). The hypostoma is very similar to that of *S. teruamanga* (Craig and Craig 1986), as are the mandibles. It could be interesting to compare the larva and adult of *S. adamsoni* with those of *S. mataverense* (Craig and Craig 1986), which unfortunately are unknown, because the pupa of *S. mataverense*, like that of *S. adamsoni*, possesses a larger number of gill filaments and pointed thoracic tubercles.

The larva of *S. adamsoni* also shows some similarities to that of an as yet undescribed species from Rurutu, Austral Islands.

The genitalia of all the available *S. adamsoni* males are very unusual. The fusion of the gonocoxae medially to the sclerotized posterior edge of sternite IX and their insertion into the abdomen to form a "genital capsule" are probably unique in the Simuliidae. The gonostyli are highly coadapted to adduct dorsally over the massive ventral plate. The cerci are large enough to appear to be "accessory dorsal claspers." The cerci of male Simuliidae are usually so insignificant that they are rarely illustrated, being normally almost unsclerotized small plates with a few sensilla, supporting either side of the anus (Crosskey 1990). In *S. adamsoni* they are located anterolaterally, articulating with tergite IX. It may be of significance that in the undescribed Rurutu species, the cerci are bladelike, considerably larger than normal, and sclerotized along the dorsal edge. Indeed, in other male simuliids from the Marquesas Islands the cerci are large enough to be easily observed (e.g., Figs. 10, 11, 12).

Craig (1987, Fig. 17) illustrated the genitalia of male *Simulium* sp., which, like those of male *S. adamsoni*, possess a posteromedial lobe on the gonocoxa, but there are no other striking similarities.

Other material

In addition to the holotype, we have seen the following: *Hiva Oa*: Teahoku: Hanaiapa, Atuona, 3-XII-83, coll. Y. Séchan (larvae, ITRMLM); Hanaiapa, 900 m altitude, 27-VII-77, coll. A. Tetuanui (♀, DAC, BMNH). Tahauku: cascade Vaiutu sur rivière Faakua, 350 m, 29-VII-88, coll. Y. Séchan (larvae, BMNH, BPBM, CNCI, DAC, ITRMLM, MNHP, NZAC; ♂, ♀, BPBM). *Fatu Hiva*: Hanavave: Vaieenui Cascade, 410 m altitude, 23-VII-88, coll. Y. Séchan (larvae, BMNH, BPBM, CNCI, DAC, ITRMLM, MNHP, NZAC; ♂, BMNH, BPBM, CNCI, DAC, ORSTOM, MNHP, NZAC; ♀, BPBM, MNHP, ORSTOM); 25-XI-1983, coll. Y. Séchan (larvae, ITRMLM).

Edwards (1932) examined females from the following locations: *Hiva Oa*: Atuona Valley, 330 ft, 6-VII-1929, coll. E.P. Mumford and A.M. Adamson (BPBM). *Fatu Hiva*: Punahitahi, Omoa (Oomoa) Valley, 650 ft, 18-VIII-1930, coll. G. LeBronnec (BPBM).

There is one female paratype of *S. adamsoni* in the BMNH (Crosskey and Lowry 1990).

Simulium (Inseliellum) buissoni Roubaud Figs. 3, 10, 16, 21, 29, 35

Simulium buissoni Roubaud, 1906: 521. Edwards, 1927: 241, confused with *S. oviceps*; Edwards, 1932: 105.

Lectotype female by present designation of D.A. Craig. *Simulium buissoni* Roubaud. Klein, Rivière, and Séchan, 1983: 23.

Simulium (Inseliellum) buissoni Roubaud. Crosskey 1988: 453; 1989: 224. Crosskey and Lowry 1990: 207.

Types

The specimens described by Roubaud (1906) were collected on Nuku Hiva in 1902 by a Dr. Buisson and apparently were originally in glycerine. A Dr. Laveran gave the material to

Roubaud in 1903. Roubaud (1906) did not designate a type and neither did Edwards (1932), and it is clear that Edwards did not examine the Roubaud material. Four pinned female syntypes were made available (to D.A.C.) by the Muséum National d'Histoire Naturelle, Paris, courtesy of Dr. L. Matile. One of these carries an old label with "Type" on it and is here designated (D.A.C.) as lectotype.

Lectotype

Pinned female. Label data: "MUSEUM PARIS/ I. Marquises/Laveran 1903", "Buissoni. nsp./ Roubaud./ Type". The following red label has been added: "*Simulium (I) buissoni* Roubaud/ LECTOTYPE/ Nuku Hiva/ Coll. Dr. Buisson".

Paralectotypes

Three pinned females. Label data: "MUSEUM PARIS/ I. Marquises/ Laveran 1903". The following yellow label has been added: "*Simulium (I) buissoni* Roubaud/ PARALECTOTYPE"/ Nuku Hiva/ Coll. Dr. Buisson".

Diagnosis

Female: mouthparts substantial, 0.6 times head depth; mandibular articulations distinct. Male: dark brown, ventral plate without flange. Pupa: six gill filaments (2+3+1), occasionally seven (2+3+2), small pointed thoracic tubercles. Larva: head brown, spots distinct, number of fan rays 24–33.

Association of all stages of *S. buissoni* is reasonably firm and was established via reared material and dissection of pharate pupal gills. However, larvae are difficult to distinguish from other Marquesan simuliid larvae, but tend to be darker.

Description

Adult female

Body: generally medium brown; 1.9–2.6 mm in length. Head: even brown; width 0.64 mm, depth 0.44 mm. Eyes: interocular distance 0.072 mm; frontal angle 76°; ommatidia 0.013 mm in diameter, ca. 28 and 30 across and up eye in middle row, respectively. Frons: evenly light brown, vestiture of coarse yellow hairs. Clypeus: 0.16–0.21 mm maximum width, broader at midlength, slightly concave laterally, heavily sclerotized, apex rounded cone-shaped, slightly paler than frons, vestiture of fine sparse pale yellow hairs; tentorium heavily sclerotized. Postocular hairs sparse, light yellow, barely extended to eye margin. Antenna: total length 0.46 mm; scape and pedicel paler than remaining flagellomeres. Mouthparts: length 0.6 times head depth; mandibles as long as labrum, 4.5 times as long as wide, mediobasal edge straight with 25 teeth, no distinct pigmentation anteromedial to sensillum; mandibular articulation with head distinct, projected laterally from clypeus, heavily pigmented with median pale incision; laciniae with 23–29 retrorse teeth; palpus 0.54 mm long, distal article as long as remainder of palpus, sensory vesicle occupying 0.4 times width of third article, opening 0.5 times width of vesicle, ca. 18 sensilla sockets visible, third article with very angular anteromedial margin with single large sensillum apically. Cibarial pump: proximal arms substantial, angular, heavily pigmented, space between shallowly U-shaped, smooth,

twice as wide as deep. Thorax: length 0.77–0.88 mm; width 0.55–0.66 mm; postpronotal lobe pale; scutum evenly medium brown (in perfect specimens clothed dorsally with coarse golden-yellow pubescence, rather dense in some specimens), anterolateral margins concolorous with postpronotal lobes, posterolateral edges over wing base heavily pigmented, extended anteriorly to demark scutum from pleuron; scutellum slightly paler than scutum, apical angle 95°, posterolateral edges slightly concave, little vestiture; postscutellum concolorous with scutellum; pleuron evenly light brown. Wing: length 1.6–1.8 mm, maximum width 0.92–0.95 mm; veins generally very pale; stem vein hair tuft sparse. Halter: knob pale with light brown pedicel. Legs: mainly dark brownish; tibiae more or less pale basally and sometimes indistinctly paler medially, with stout tibial spines; first hind tarsomere mainly pale, apical 1/4 or 1/5 darkened; vestiture of tibiae coarse and yellowish throughout, or at least on basal 3/4; first hind tarsomere almost as long as tibia, deepest medially, less deep at apical third; cal-cipala extends to 0.5 times length of second tarsomere; spines of wing comb extended fully along tarsomere and cal-cipala. Pretarsal claw with basal tooth 0.33 times length of claw, forming 4° angle with claw tip. Abdomen: generally light brown with vestiture of golden hairs; segments VI and VII somewhat darker; basal fringe of hairs extended only to first abdominal segment; tergites I and II narrow and extended across segments, tergite III small, slightly broader than long, tergites IV and V as broad as long, tergites VI and VII broader than long, tergite VIII continuous across segment, tergites III–VI dull, tergites VII–IX subshiny; pleural regions concolorous with tergum, extended 2/3 distance around segment; sternum very pale except on segment VIII, concolorous with tergum. Genitalia (Fig. 3): sternite VIII with patch of fine hairs medially; cercus angular posterodorsally, rounded ventrally; anal lobe barely extends beyond cercus base, with hairs ventromedially; hypogynial valves broadly rounded apically, extend to 0.5 times length of anal lobe, sparse vestiture of coarse black hair, and evenly arrayed microtrichia; median space between broadest posteriorly, broadly rounded anteriorly, not extended anteriorly to branch of genital fork; genital fork stem narrow; lateral arms slightly flanged, anterolateral extensions with acute angle anteriorly. Spermatheca ovoid, evenly light brown, no pattern, distinct clear area at spermathecal duct junction.

Adult male (based on two reared specimens from Hoata and pharate specimens from Tcheko, Nuku Hiva)

Body: generally blackish brown; length 1.96 mm. Head: width 0.62 mm, depth 0.48 mm. Eyes: upper ommatidia 0.027 mm in diameter, 14 rows up and across eye; lower ommatidia 0.012 mm in diameter, 22 and 32 rows up and across eye, respectively; division between upper and lower ommatidia not distinct except for colour. Clypeus: 0.32 times as wide as head. Antenna: length 0.35 mm; scape and pedicel darker than flagellum. Mouthparts: length 0.26 times head depth; mandibles ca. 0.25 length of labrum, with three fine elongate projections apically; laciniae with apical hairs; palpus 0.37 mm long, distal article 0.16 mm; third article with distinct distal median angle, sensory vesicle occupying 0.25 times of width of article, opening 0.3 times width of vesicle, ca. four sensillar sockets visible. Thorax: length 0.84 mm; postpronotum and scutum brownish black, scutum

with sparse vestiture of golden hairs; scutellum slightly paler, sparse vestiture of coarse long black hairs. Wing: length 1.4 mm, maximum width 0.78 mm; stem vein hair tuft not observed. Halter: knob and pedicel pale. Legs: coxae and femora dark brown, with vestiture of coarse black hairs, tibiae lighter. Pretarsal claw with ca. 15 grappling hooks dorsally. Abdomen: mottled yellowish brown dorsally; vestiture of coarse black hairs; basal fringe of long black hairs extended to second abdominal segment; tergites subshiny; pleuron mottled gray; sternites squarish and shiny. Genitalia (Fig. 10): gonocoxa 0.8 times as long as basal width; gonostylus ca. 0.3 times as wide as long, narrow, curved and tapered rapidly to apex, single blunt terminal spine; ventral plate with median posterior apex broadly angular, small patch of fine vestiture medially, margins back to lateral angle straight, sides slightly concave and expanded anteriorly to base of curved fluted anterior arms, anteromedial region between arms distinctly domed with variable median notch. Cerci: substantial, extended posteriorly to ca. 0.5 times length of gonostylii.

Pupa

Length: male 1.5 mm, female 1.9–2.3 mm. Gill (Fig. 16): 1.9–2.7 mm in length; six filaments, 2+3+1, main stem forked close to base into dorsal and ventral branches, ventral branch forked again at 0.5 times length, dorsal branch branched at 0.33, 0.5, and 0.66 times total length, considerable variation in branching pattern, especially in dorsal branch. Thorax: cuticle pale yellow; tubercles small, sharply cone-shaped. Abdomen: sternite III bare, sternite IV with 2 spines, cuticle with small tubercles, sternite V with 4 bifurcated spines medially, sternite VI with 4 bifurcated spines widely spaced, sternite VII with 2 trichoid spines placed laterally; tergite I with a single trichoid spine placed laterally, cuticle with small tubercles, tergite II with 8 small spines and occasionally 1 anteriorly, tergites III and IV with 8 substantial spines, tergite V essentially bare, occasionally 2 small fine spines, tergites VI and VII with 8–10 posteriorly directed spines, tergite VIII with 14–16 small spines, tergite IX with many small spines; terminal spines directed posteriorly, not sinuous laterally, sharp apically. (Klein et al. (1983) give finer details of hooks and spines.) Cocoon rather closely woven, extended almost completely over thorax dorsally, ventrally to head, posterior floor extended anteriorly only to tips of wing pads, ventral margins attached to substrate vertically, occasionally slightly reflexed under pupa.

Larva

Last-instar larva with dark pharate pupal gills; length 4.1–4.5 mm. Body: generally very pale grayish brown (variable, depending on fixative). Head (Fig. 21): length 0.60–0.66 mm, width 0.50–0.51 mm; distance between fan stem bases 0.35 mm; lateral margins only slightly concave; generally light brown, frontoclypeal apotome pale anteriorly, darker posteromedially with very characteristic figure-8-shaped pattern produced by negative head spots, cuticle on either side of ecdysial line pale, two distinct head spots anterolaterally of postocciput; cervical sclerites very small and indistinct, not fused to postocciput; stemmata surrounded by clear area. Antenna: with most of distal article extended beyond labral fan, distal article 0.13 mm, proximal article 0.25 mm, proximal and distal articles light brown and

concolorous, median article lighter. Labral fans: 25–33 rays, ca. 0.89 mm in length; posterolateral rays not significantly shorter than others; microtrichia of medial rays up to 1.8 times longer than ray width, longer microtrichia with 4 or 5 smaller ones decreasing markedly in size to next long one. Hypostoma (Fig. 29): 13 teeth; median tooth prominent, extended slightly beyond lateral teeth; 3 sublateral teeth; 2 paralaral teeth; three or four small lateral serrations; three or four hypostomal setae per side. Postgenal cleft: decreasing slightly in width anteriorly, squarish anteriorly usually with median projection. Postgenal bridge: slightly longer than cleft depth, pale, slightly darker at cleft apex. Head setae normal. Mandible (Fig. 35): tooth posterior to apical tooth slightly more than 0.5 times length of apical tooth; 7 spinous teeth; distance between spinose teeth and serration approximately one basal width of serration; serration as high as basal width; sensillum 0.5 times length of serration; cuticle posterior to sensillum with minute but distinct anteriorly pointed serrations. Maxillary palpus: 3.0 times as long as basal width. Mandibular phragma: extended ventrally to 0.3 times depth of maxilla base. Prothoracic proleg: dorsolateral sclerite extended full length of distal article. Abdomen: segments I–IV increased very slightly in size posteriorly, expanded rapidly to segment V, and further to segment VII, then decreased evenly; posteroventral tubercles small but distinct; posterodorsal cuticle with no obvious cuticular pattern. Anal sclerite: posteroventral arms 1.3 times length of dorsolateral arms, not fused to simple lateral accessory sclerites. Cirlet of hooks: ca. 74 rows of hooks, 14 or 15 hooks per row. Anal papillae: simple.

Bionomics

Simulium buissoni is the infamous “nono noir” of the Marquesas Islands and is seriously ornithophilic and anthropophilic (Roubaud 1906; Cheesman 1932; Edwards 1927, 1932; Lavondes and Pichon 1972; Klein et al. 1983).

The larvae are found in most running-water habitats on Nuku Hiva and Eiao, including cascades. Larvae and pupae are found on rocks, leaves, and trailing vegetation.

In recent times, *S. buissoni* is known to be anthropophilic only on Eiao and Nuku Hiva (Lavondes and Pichon 1972). Therefore, the records (Fig. 1) of this species on other islands (Edwards 1932; Klein et al. 1983; this work) should be viewed with caution, since they may well involve another species, as indicated below.

Comments

Further analysis is expected to show that *S. buissoni* and *S. sechani* are sister taxa. It is also very likely that *S. buissoni* will be shown to be a complex of species because of the substantial variation in body size of adult females and in larval structures, particularly the labral fans. However, these variations may well be the result of temporal and nutritional factors.

Other material

In addition to the types we have seen the following:

Eiao: Vaituha: near sea level, coll. A.M. Adamson (♀ ♀, det. F.W. Edwards, BPBM); Vaituha Valley, 100 ft, ?-XI-1929, coll. E.P. Mumford and A.M. Adamson (larvae, pupae, ♀ ♀, BPBM); Vaituha Vall. 200 ft, 3-X-1929, coll.

E.P. Mumford and A.M. Adamson (larvae, det. F.W. Edwards, BPBM); 100 ft, 2-X-1929, coll. E.P. Mumford and A.M. Adamson (larvae, det. F.W. Edwards, BPBM); 2-X-1929, coll. E.P. Mumford and A.M. Adamson (larvae, det. F.W. Edwards, BPBM); mur cascade, baie de Vaituha, 4-II-1972, coll. Y. Séchan (larvae, pupae, ITRMLM; ♀, BPBM); amont de la cascade, 120 m, 8-VII-1988, coll. Y. Séchan (♀ ♀, BMNH, BPBM, CNCI, DAC, ITRMLM, MNHP, NZAC); 8-VII-1988, plage, capturer sur “Pera,” coll. Y. Séchan (dried ♀ ♀, ITRMLM); confluent de la rivière/source, 120 m, 8-VII-1988, coll. Y. Séchan (larvae, pupae, ITRMLM; larvae BPBM, ♀ ♀, BMNH, BPBM, CNCI, DAC, ITRMLM, MNHP, NZAC, ORSTOM).

Nuku Hiva: Tevanui: 2000 ft, 24-X-1929, coll. E.P. Mumford and A.M. Adamson (larvae, det. F.W. Edwards, BPBM). Taiohae: village, 24-I-1929, coll. E.P. Mumford and A.M. Adamson (♀ ♀, det. F.W. Edwards, BPBM). Hakau: valley, ?-XI-1929, coll. E.P. Mumford and A.M. Adamson (♀ ♀, det. F.W. Edwards, BPBM). Tapuaooa: 3100 ft, 14-XI-1929, Pacific Entomological Survey, coll. E.P. Mumford and A.M. Adamson (♀ ♀, det. F.W. Edwards, BPBM). Hoata: amont ancien réservoir, 16-VII-1988, coll. Y. Séchan (larvae, pupae, ITRMLM); 290 m, 16-VII-1982, coll. Y. Séchan (pupae, ♂ ♂, ITRMLM). Taipivai: capturé sur homme dans maison, 8.30–9.30 hrs, 22-XI-1981, Coll. J.M. Klein (♀ ♀, ITRMLM); grande rivière, village, 23-XI-1981, coll. J.M. Klein (♀ ♀, ITRMLM); cascade Vaiahu, 100 m, 23-XI-1981, coll. F. Rivière (pupae, reared ♂, BPBM); +123 m, 23-XI-1981, coll. F. Rivière (larvae, ITRMLM); rivière du captage, 25-XI-1981, coll. F. Rivière (pupa, ITRMLM); rivière du nouveau captage, 7 and 8-XII-1982, coll. Y. Séchan (larvae, ITRMLM); bae de cascade Vaiahu, 24-XI-1982, coll. Y. Séchan (larvae, pupae, ITRMLM); confluent Teuakueenui-Mahuiki, 3-XII-1988, coll. Y. Séchan (larvae, pupae, ITRMLM). Tcheko: en amont route, 640 m, 2-XII-1982, coll. Y. Séchan (larvae, pupae, ITRMLM, BPBM). Hakau: rivière, de la source (“mape”), 120 m, 14-XII-1982, coll. Y. Séchan (larvae, ITRMLM). Taiohae: amont réservoir sur 1^{ième} rivière rive gauche, 130 m, 23-III-1972, coll. Y. Séchan (pupae, BMNH, BPBM, CNCI, DAC, ITRMLM, MNHP, NZAC); Pahaatea, cimetièrre, maison, 4-III-1986, coll. A. Tetuanui (♀ ♀, BMNH, BPBM, CNCI, DAC, ITRMLM, MNHP, NZAC). Vaipae: rivière rive droite Vallée Française, torrent, 10 m, 15-XI-1981, coll. F. Rivière (larvae, ITRMLM); 400 m, 15-XI-1981, coll. F. Rivière (larvae, ITRMLM). Hoomui: plage, 27-XI-1981, coll. F. Rivière (♀ ♀, ITRMLM).

Ua Huka: Vaipae: rivière, 10 m, 15-XI-1981, coll. F. Rivière and J.M. Klein (larvae, ITRMLM); +400 m, 15-XI-1981, coll. F. Rivière and J.M. Klein (larvae, ITRMLM). Hokatu: amont du village, 300 m, 16-XI-1981, coll. F. Rivière (larvae, ITRMLM).

Ua Pou: Hakahau: au filet amont village, 7-XII-1971, coll. Y. Séchan (♀ ♀, ITRMLM). Hakatao: amont village, 10-V-1972, coll. Y. Séchan (♀ ♀, ITRMLM). Hakamaui: rivière en amont village, 9-V-72, coll. Y. Séchan (pupae, ITRMLM); ?-II-1972 (pupae, ITRMLM). Haakuti: amont village, +400 m, 20-XI-1981, coll. A. Tetuanui (larvae, ITRMLM, BPBM). Hakahetau: 100 ft, 5-XII-1929, coll.

E.P. Mumford and A.M. Adamson (larvae, det. F.W. Edwards, BPBM); Kaupua vallée, 23-VII-1977, coll. F. Rivière and J.M. Klein (♀♀, ITRMLM); River, +600 m, 19-XI-1981, coll. J.M. Klein (larvae, ITRMLM).

Hiva Oa: Tahauku: 22-VIII-1929, coll. E.P. Mumford and A.M. Adamson, (♀♀, det. F.W. Edwards, BPBM). Atuona: Valley, 28-III-1929, coll. E.P. Mumford and A.M. Adamson, (♀♀, det. F.W. Edwards, BPBM).

There is one female syntype of *S. buissoni* in the BMNH (Crosskey and Lowry 1990). This now becomes a paralectotype, following the lectotype designation herein.

Simulium (Inseliellum) gallinum Edwards

Figs. 4, 11, 17, 22, 30, 36

Simulium buissoni gallinum Edwards, 1932: 108.

Simulium gallinum Edwards. NEW STATUS: Klein, Rivière, and Séchan 1983: 22.

Simulium (Inseliellum) gallinum Edwards. Crosskey, 1988: 454; 1989: 224. Crosskey and Lowry, 1990: 214.

Types

Holotype: Female: pinned. Label data: "Atuona Valley/HivaOa 325 ft/ vii-6-1929", "Marquesas/ Islands", "Mumford/ Adamson", "Pacific Entomo/logical Survey", "Type", *S. buissoni/ var. gallinum/ F.W. Edwards/ det.*, "Holotype/ No. 585/ *Simulium/ buissoni/ gallinum/ Edwards*", (BPBM).

Diagnosis

Female: smaller body size; overall blackish brown; smaller mouthparts. Male: smaller body size; overall blackish brown; scutum with vestiture of golden hairs. Pupa: four gill filaments (2+2); small, pointed thoracic tubercles. Larva: overall very pale brown; 25–30 fan rays.

Association of stages of *S. gallinum* is equivocal. Except for their smaller mouthparts and size, females are difficult to distinguish from those of most other Marquesan simuliid species. Pupae are clearly recognizable, having only four gill filaments. The larvae are also virtually impossible to distinguish, and may have been confused here with those of *S. rivierei*.

Description

Adult female

Body: overall medium to dark brown; 1.6–1.9 mm in length. Head: even dark brown; width 0.56 mm, depth 0.37 mm. Eyes: interocular distance 0.05 mm; frontal angle 71°; ommatidia 0.012 mm in diameter, ca. 22 and 25 across and up eye in middle row, respectively. Frons: evenly dark brown. Clypeus: concolorous with frons, slightly longer than wide, vestiture of sparse fine pale-yellow hairs. Postocular hairs: sparse, light yellow, barely extended to eye margin. Frons: vestiture of coarse yellow hairs. Antenna: total length 0.40 mm; scape and pedicel paler than remaining flagellomeres. Mouthparts: length 0.3 times head depth. Mandibles as long as labrum, 4 times as long as wide, mediobasal surface straight with 19 teeth. Lacinia: with 20–22 retrorse teeth. Palpus: 0.3 mm long, distal article 0.33 times total

length of palpus, sensory vesicle occupying 0.66 times width of third article, opening 0.5 times width of vesicle, third article with very angular anterodistal margin. Cibarial pump: proximal arms substantial, angular, heavily pigmented, space between shallowly U-shaped, smooth. Thorax: length 0.6–0.7 mm, width 0.50–0.55 mm; postpronotal lobe brown; scutum even dark brown, vestiture of coarse golden-yellow hairs; scutellum concolorous with scutum, apical angle 112°, posterolateral edges slightly convex, vestiture essentially absent; postscutellum concolorous with scutellum; pleuron evenly light brown. Wing: length 1.7 mm, maximum width 0.8 mm; veins generally very pale; stem vein hair tuft sparse, more substantial in newly eclosed specimens. Halter: knob and pedicel pale. Legs: mainly brownish, hind femur with more or less definite darker proximal zone, others evenly brownish; tibiae more or less pale basally and paler medially, with sparse vestiture, tibial spines stout; first hind tarsomere mainly pale, but slightly darker on both ends, almost as long as tibia, deepest medially, less deep at apical third; calcipala extended to 0.5 times length of second tarsomere. Pretarsal claw with basal tooth 0.5 times length of claw, forming 5° angle with claw tip. Abdomen: generally dark brown with vestiture of golden hairs. Basal fringe of hairs extended to third abdominal segment, tergites I and II narrow and extending across segments, tergite III small, tergites III–VI slightly broader than long, tergite VII broader than long, tergite VIII continuous across segment; tergites subshiny; pleural regions concolorous with tergum; sternum pale, except on segment VIII, which is concolorous with tergum. Genitalia (Fig. 4): cercus evenly rounded dorsally, more sharply rounded ventrally, vestiture of even short hairs; anal lobe extended only to base of cercus, with hairs ventromedially; hypogynial valves distinctly rounded apically, extend 0.3 times length of anal lobe, with sparse vestiture of short hairs and trifid microtrichia laterally, single microtrichia medially; median space extended anteriorly to branch of genital fork, narrowly rounded anteriorly, slightly wider at mid-depth, pigmented area at mid-depth; stem of genital fork narrow, lateral arms flared posteriorly, with accessory fluted lobe posteromedially, posterolateral angle acute. Spermatheca ovoid, evenly light brown, no pattern, distinct clear area at spermathecal duct junction.

Adult male (based on two males from Vaitahu, Tahuata)

Body: generally blackish brown; length 1.8 mm. Head: width 0.62 mm, depth 0.48 mm. Eyes: upper ommatidia 0.033 mm in diameter, 9 and 10 rows up and across eye, respectively; lower ommatidia 0.012 mm in diameter, ca. 22 and 32 across and up eye in middle row, respectively; division between upper and lower ommatidia not distinct except for colour. Clypeus: 0.11 times as wide as head. Antenna: total length 0.25 mm; pedicel and scape lighter than brown flagellum. Mouthparts: 0.27 times head depth; mandibles not observed, probably absent; laciniae with distal hairs only, 0.75 times length of labrum; palpus 0.37 mm long, distal article 0.16 mm; sensory vesicle occupying only 0.25 times width of third palpal article, opening less than 0.33 times width of vesicle, ca. four sensilla sockets visible. Thorax: length 0.65–0.67 mm, width 0.56–0.58 mm; postpronotum and scutum brownish black; scutum with sparse vestiture of

golden hairs; scutellum concolorous with scutum and postnotum. Wing: length 1.4 mm, maximum width 0.78 mm, stem vein hair tuft not observed. Halter: pale. Legs: coxae, femora, and tibiae light brown, with sparse vestiture of black hairs, femora and tibiae with slightly lighter zone medially. Pretarsal claw with 16 grappling hooks dorsally. Abdomen: blackish brown dorsally; vestiture of coarse black hairs; basal fringe of long black hairs extended to fourth abdominal segment; tergites subshiny; pleuron mottled gray; sternites squarish and shiny. Genitalia (Fig. 11): Gonocoxa 2.5 times as long as basal width; gonostylus 3.0 times as long as basal width, slender, gently curved, single blunt terminal spine; ventral plate rounded apically, concave edges to broadly rounded lateral angle, vestiture of small posterior patch of fine hairs, anterior arms short, median edge extended anteriorly with deep, rounded notch. Cerci: very substantial, extended almost to end of gonostylii.

Pupa

Length: male 1.5 mm, female 1.9–2.3 mm. Gill (Fig. 17): 1.9–2.7 mm in length; four filaments (2+2), main stem branching close to base, both branches dividing at 0.5 times length, but with considerable variation in branching point of dorsal branch, even on same specimen. Thorax: cuticle pale yellow; tubercles small, rounded cone-shaped, more distinct in some specimens. Abdomen: sternite III bare, sternite IV with two bifurcated spines, cuticle with small tubercles, sternite V as for IV but with 4–6 bifurcated spines medially, sternite VI as for V, but spines widely separated, sternite VII with 4 trichoid spines placed laterally; tergite I bare, but with low tubercles, tergite II with 8 small spines and tubercles, tergites III and IV with 8 substantial spines, tergite V bare, tergite VI with a row of single spines, tergite VII with 6–8 posteriorly directed spines and lateral row of spine combs; tergite VIII with 16–18 spines, tergite IX with many small spines; terminal spines short, directed posteriorly, not sinuous laterally, pointed apically. Cocoon rather closely woven, extended almost completely over thorax dorsally, ventrally to head, no floor beneath thorax, ventral margins typically reflexed medially at attachment point to substrate.

Larva

Last-instar larvae with dark pharate pupal gills: length 4.1–4.5 mm. Body: generally very pale grayish brown (variable, depending on fixative). Head (Fig. 22): width 0.51 mm, length 0.46 mm, distance between fan stem bases 0.35 mm; lateral margins only slightly concave; generally light brown; frontoclypeal apotome pale anteriorly, darker postero-medially with very characteristic figure-8-shaped pattern produced by negative head spots, cuticle on either side of ecdysial line pale, two head spots anterolaterally of occipital sclerite; cervical sclerites very small and indistinct, not fused to postocciput. Stemmata surrounded by clear area. Antenna: with most of distal article extended beyond stem of labral fan, distal article 0.13 mm, proximal and medial articles 0.25 mm, proximal and distal articles light brown and concolorous, median article lighter. Labral fans: 25–30 rays, ca. 0.89 mm in length; microtrichia of medial rays up to 1.8 times longer than ray width, longer microtrichia with 4 or 5 smaller ones decreasing markedly in size to next long one. Hypostoma (Fig. 30): 13 teeth; median tooth promi-

nent, often extended beyond lateral teeth; 3 sublateral teeth; 2 paralateral teeth; three or four small lateral serrations; three or four hypostomal setae per side. Postgenal cleft: expanded slightly posteriorly, squarish anteriorly. Postgenal bridge: slightly longer than cleft depth, pale, darker at cleft apex in some specimens. Head setae normal. Mandible (Fig. 36): tooth posterior to apical tooth slightly more than 0.5 times length of apical tooth; then 2 substantial teeth, slightly more than 0.5 times length; 7 spinous teeth; distance between spinous teeth and serration approximately one basal width of serration; serration as high as basal width; sensillum 0.5 times length of serration; cuticle posterior to sensillum essentially smooth, in some specimens with minute anteriorly pointed serrations. Maxillary palpus 3.0 times as long as basal width. Mandibular phragma: extended ventrally to 0.3 times depth of maxilla base. Prothoracic proleg: dorso-lateral sclerites lightly pigmented, not extended full length of distal article. Abdomen: segments I–IV increased very slightly in size posteriorly, expanded markedly to segment V and further to segment VII, then decreased gradually (amphora-shaped); posteroventral tubercles small but distinct; postero-dorsal cuticle with no obvious cuticular pattern. Anal sclerite: posteroventral arms 1.3 times longer than dorsolateral arms, not fused to simple lateral accessory sclerites. Circlet of hooks: ca. 60 rows of hooks, 12–14 hooks per row. Anal papillae: simple.

Bionomics

Simulium gallinum is not known to be anthropophilic (Lavondes and Pichon 1972), but it is certainly ornithophilic. Edwards (1932) noted that females he examined were taken from birds, and some females examined during this study contained blood meals. Larvae are found on roots, leaves, and stones in small rivers with low velocity.

Comments

Further collecting and rearing will be needed to distinguish the larvae and pupae of *S. gallinum* from those of *S. rivièri* and *S. pichoni*. *Simulium gallinum* and *S. pichoni* are the only two species in which the females have a medial flange on the arm of the genital fork (cf. Figs. 4, 7), but the genitalia of the males of these two species are quite different (cf. Figs. 11, 13).

Other material

In addition to the holotype we have seen the following: *Ua Pou*: Hakamoui: 300 m, 18-XI-1981, coll. F. Rivière (pupa, ITRMLM). Hakatao: 10-X-1972, coll. Y. Séchan (pupa, ITRMLM). Hakamaï: 9-V-72, coll. Y. Séchan (pupae, ITRMLM).

Hiva Oa: Mataovai: 5-VI-1929, 370 ft, coll. E.P. Mumford and A.M. Adamson (♀♀, BPBM). Tanaeka: valley, 1100 ft, 4-VI-1929, coll. E.P. Mumford and A.M. Adamson (♀♀, BPBM). Atuona: valley, 325 ft, 6-VII-1929, coll. E.P. Mumford and A.M. Adamson (♀, BPBM); Vaioa; rivière, amont village de Atuona, 4-II-1981, coll. F. Rivière (pupae, ITRMLM). Hanaiapa: 5-II-1972, coll. Y. Séchan (larvae, ITRMLM); 900 m, 27-VII-1972, coll. A. Tetuanui (adults, ITRMLM). Tahauku: 22-XI-83, coll. Y. Séchan (♂♂, ♀♀, ITRMLM); cascade Vaipae: 650 m, 29-VII-1988,

coll. Y. Séchan (larvae, ♂♂, ♀♀, ITRMLM, BPBM). Outukua: rivière, 300 m, 6-XI-1981, coll. F. Rivière (larvae, reared ♀♀, ITRMLM).

Tahuata: Vaitahu: vallée sud cascade 10-XI-1981, coll. F. Rivière (larvae, ITRMLM); cascade, 400 m, 10-XI-1981, coll. F. Rivière (larvae, ITRMLM); 500 m, 11-XI-1981, coll. F. Rivière (larvae, ITRMLM); rivière nord, 11-XI-1981, coll. F. Rivière (larvae, ITRMLM); 27-VII-1987, coll. Y. Séchan (larvae, pupae, ♀♀, ITRMLM, BPBM). Hanatetena: 6-II-1986, coll. Y. Séchan (larvae, pupae, ITRMLM).

Fatua Hiva: No locality, no date, coll. ? (larvae, ITRMLM). Moumanui: plateau, 20-VII-1988 coll. Y. Séchan (larvae, ITRMLM); Omoa: vallée, 1-VIII-1977, coll. A. Tetuanui (♀♀, ITRMLM); 26-XI-83, coll. Y. Séchan (pupae, ITRMLM, BMNH, BPBM, CNCI, DAC, ITRMLM, MNHP, NZAC, ORSTOM); 24 and 26-XI-1983 (larvae, ITRMLM); rivière, 30 m, 20-VII-1988, coll. Y. Séchan (larvae, ITRMLM); dernier pont, 22-VII-1988, coll. Y. Séchan (pupa, ♀, ITRMLM); vallée, 22-VII-1988, coll. Y. Séchan (♀♀, ♂♂, ITRMLM, BMNH, BPBM, CNCI, DAC, ITRMLM, MNHP, NZAC, ORSTOM); ?-XI/XII-1983, coll. Y. Séchan (pupae, ITRMLM). Hanavave: 12-XII-1972, coll. Y. Séchan (♀♀, ITRMLM); 25-XI-1983, coll. Y. Séchan (larvae, pupae, ♀♀, ITRMLM); 1^{ière} rivière avant Hanavave, 430 m, 21-VII-1988, coll. Y. Séchan (larvae, pupae, ITRMLM); 2^{ième} rivière, 2^{ième} cascade, 21-VII-1988, coll. Y. Séchan (larvae, ITRMLM); bas de Vaieenui cascade, 23-VII-1988, coll. Y. Séchan (pupae, ITRMLM); Vaieenui cascade, 410 m, 23-VII-1988, coll. Y. Séchan (larvae, pupae, ♀♀, BMNH, BPBM, CNCI, DAC, ITRMLM, MNHP, NZAC, ORSTOM); petite courant, 650 m, 25-VII-1988, coll. Y. Séchan (larvae, ITRMLM); plateau, rivière de la cascade, 750 m, 25-VII-1988, coll. Y. Séchan (larvae, ITRMLM); 25-VII-1988, 430 m, coll. Y. Séchan (larvae, ITRMLM). Hoia: 24-XI-1983, coll. Y. Séchan (pupae, ♀♀, ITRMLM). Viahae: 1^{ère} rivière avant Hanavave, 21-VII-1988, coll. Y. Séchan (larvae, ITRMLM, BMNH, BPBM, CNCI, DAC, ITRMLM, MNHP, NZAC, ORSTOM).

Klein et al. (1983) recorded *S. gallinum* from the following locations: Ua Huka: Vaipae; Ua Pou: Hakahetau, Hakahau, Paumea, Hikeu, Hokaotu, Hohoi, Haakuti, and Aneou; Hiva Oa: Hanatekuua, Tahauku, and Puamau; Tahuata: Tehue.

Simulium (Inseliellum) hukaense Séchan
Figs. 5, 12, 18, 23, 27, 31, 37

Simulium hukaensis Séchan in Klein, Rivière and Séchan 1983: 24. (Incorrect gender ending.)

Simulium (Inseliellum) hukaense Séchan, Crosskey 1988: 454; 1989: 224.

Types

According to Klein et al. (1983), the holotype was a slide preparation of a last-instar larva from Ua Pou, with acquisition number "7251," deposited in the Collection d'Entomologie médicale du Centre ORSTOM de Bondy, France.

Paratypes were last-instar larvae, 4 from Ua Pou, 12 from Ua Huka, and 6 from Nuku Hiva. However, the material was not deposited with ORSTOM (Dr. J.P. Hervy, Centre ORSTOM, Montpellier, France, personal communication, 1993), and its whereabouts are unknown.

Article 75 of The International Code of Zoological Nomenclature (3rd ed., 1985) allows designation of a neotype under certain circumstances and conditions. All are met for *S. hukaense*.

Pupae clearly identifiable (Klein et al. 1983) as *S. hukaense* were available from all localities of the mislaid type material. However, the best association of adults to pupae was in material from Ua Huka. Therefore, the neotype is designated (D.A.C.) as follows:

Neotype

Pinned female. Label data: "♀ *Simulium hukaense*", "Marquesas, Ua Huka/Haavei coll. Y. Séchan, /?-xii-1985 /Det. D.A. Craig 1994", "NEOTYPE /# 15.404" (red) (BPBM).

There is no provision under the Code for other types when a neotype is designated. However, material in exemplary condition from the same collection as the neotype has been deposited in various institutions (see "Other material" below).

Diagnosis

Female: blackish brown, mouthparts less substantial than those of *S. buissoni*. Male: blackish brown, scutum highly convex. Pupa: seven gill filaments (2+3+2). Larva: lighter in colour than *S. buissoni*.

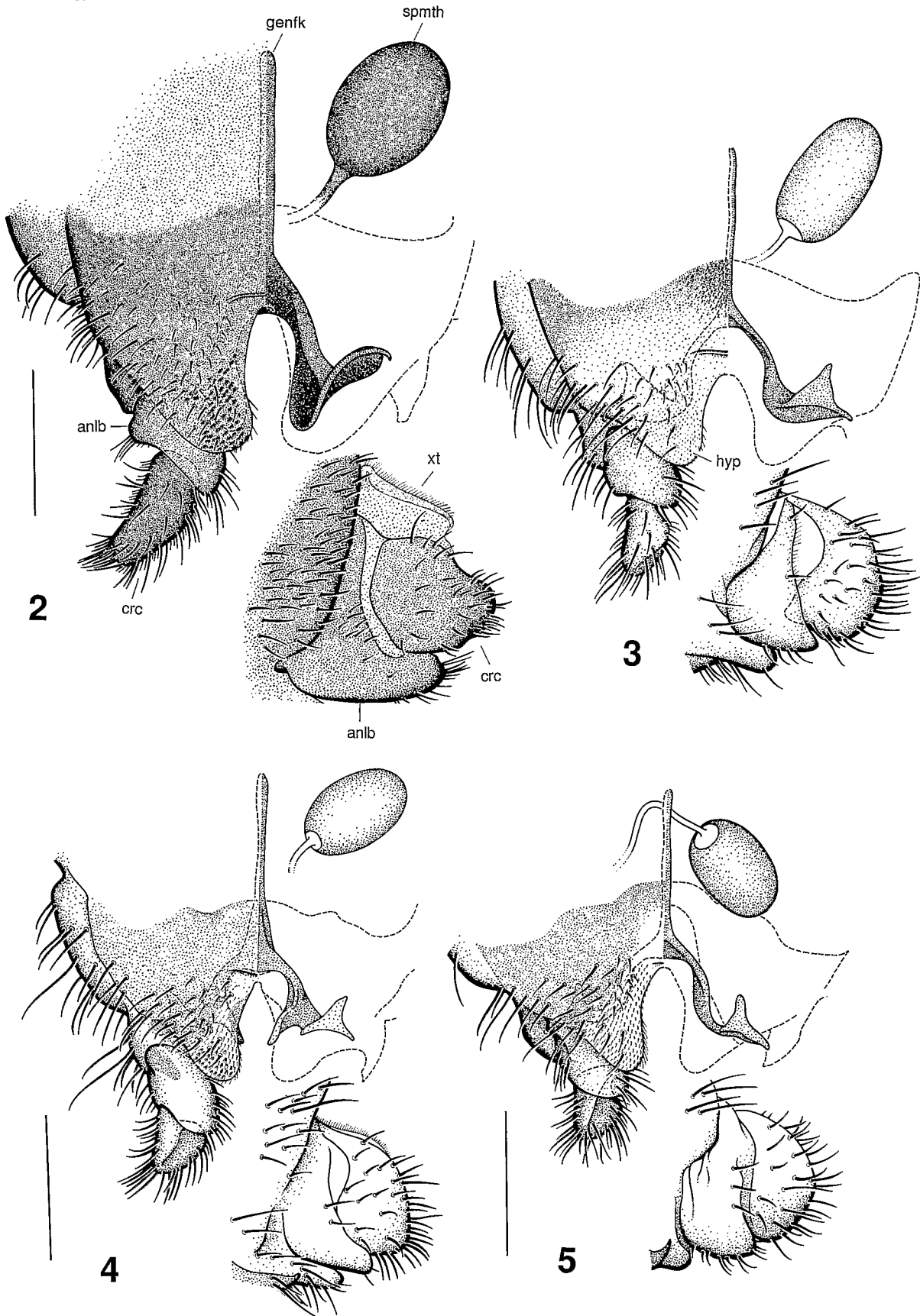
Association of stages of *S. hukaense* is somewhat equivocal. There was no reared adult material from pupae identifiable as *S. hukaense*, so material used here for description was that from collections which had only pupae identifiable as *S. hukaense*. Since *S. buissoni*, *S. gallinum*, and *S. uaense* are sympatric with *S. hukaense*, further detailed collecting and rearing may be needed to confirm the association of life stages.

Description

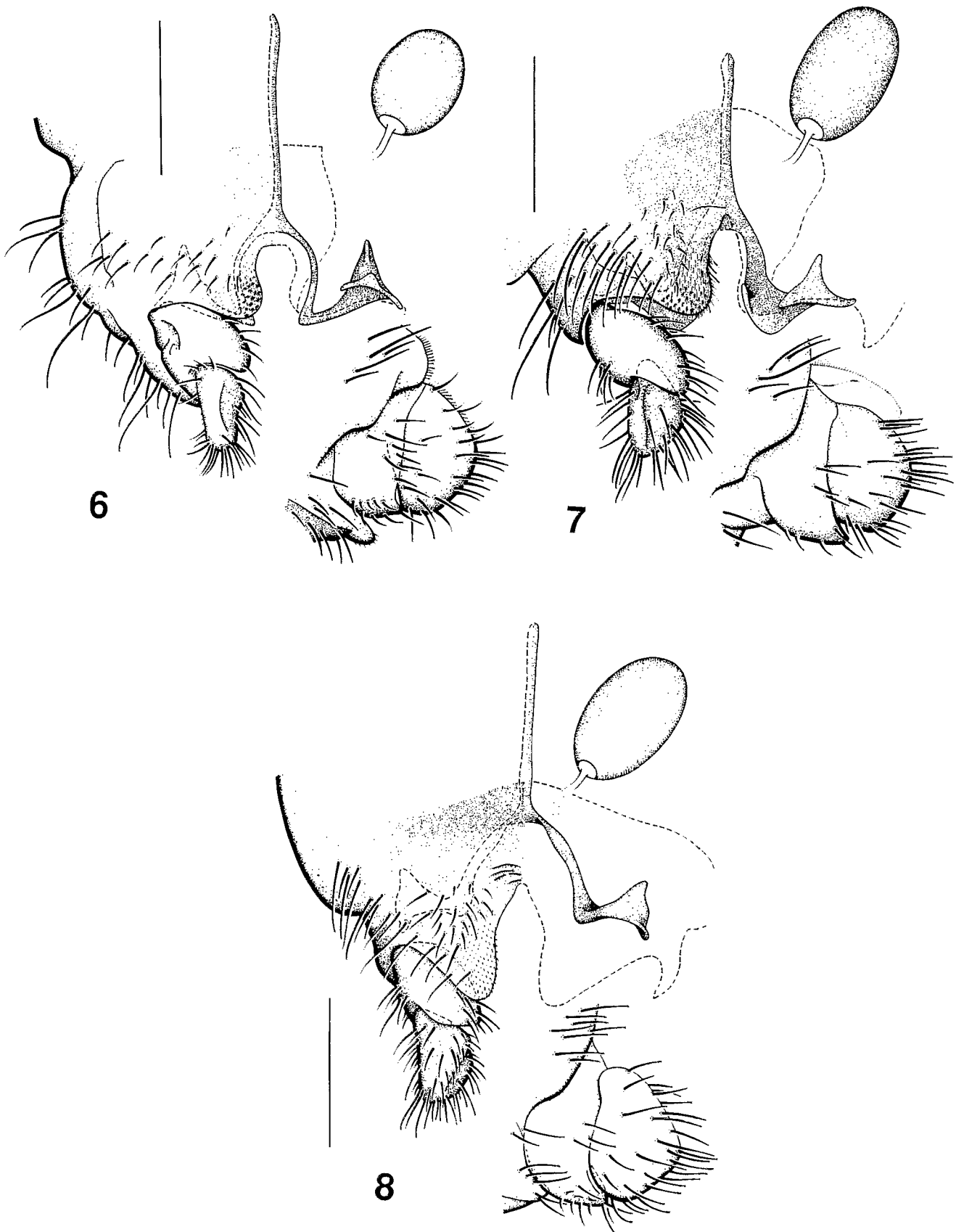
Adult female

Body: overall blackish brown; length 1.3–1.7 mm. Head: evenly very dark brown; width 0.61–0.65 mm; depth 0.36–0.44 mm. Eyes: interocular distance 0.07 mm; frontal angle 76°; ommatidia 0.012 mm in diameter, approximately 27 and 35 across and up eye in middle row, respectively. Frons: concolorous with vertex, vestiture of fine silvery hairs. Clypeus: 0.17 mm at maximum width, evenly dark brown, broadly triangular at apex and pale sparse vestiture of even short fine pale hairs. Antenna: total length 0.38–0.42 mm; scape, pedicel, and flagellomeres medium brown. Mouthparts: length 0.5 times head depth. Mandibles 4 times as long as wide, slightly pigmented to just apically of sensillum, mediobasal edge straight with 18 teeth. Laciniae with 24 retrorse teeth. Palpus: 0.45 mm long, distal article paler, slightly longer than remainder of palpus; sensory vesicle occupying 0.5 times width of third article, opening 0.3 times width of vesicle, ca. 14 sensilla sockets visible; third article dark brown with distinctly angular anteromedial margin with two or three long sensilla on angle. Cibarial pump: proximal

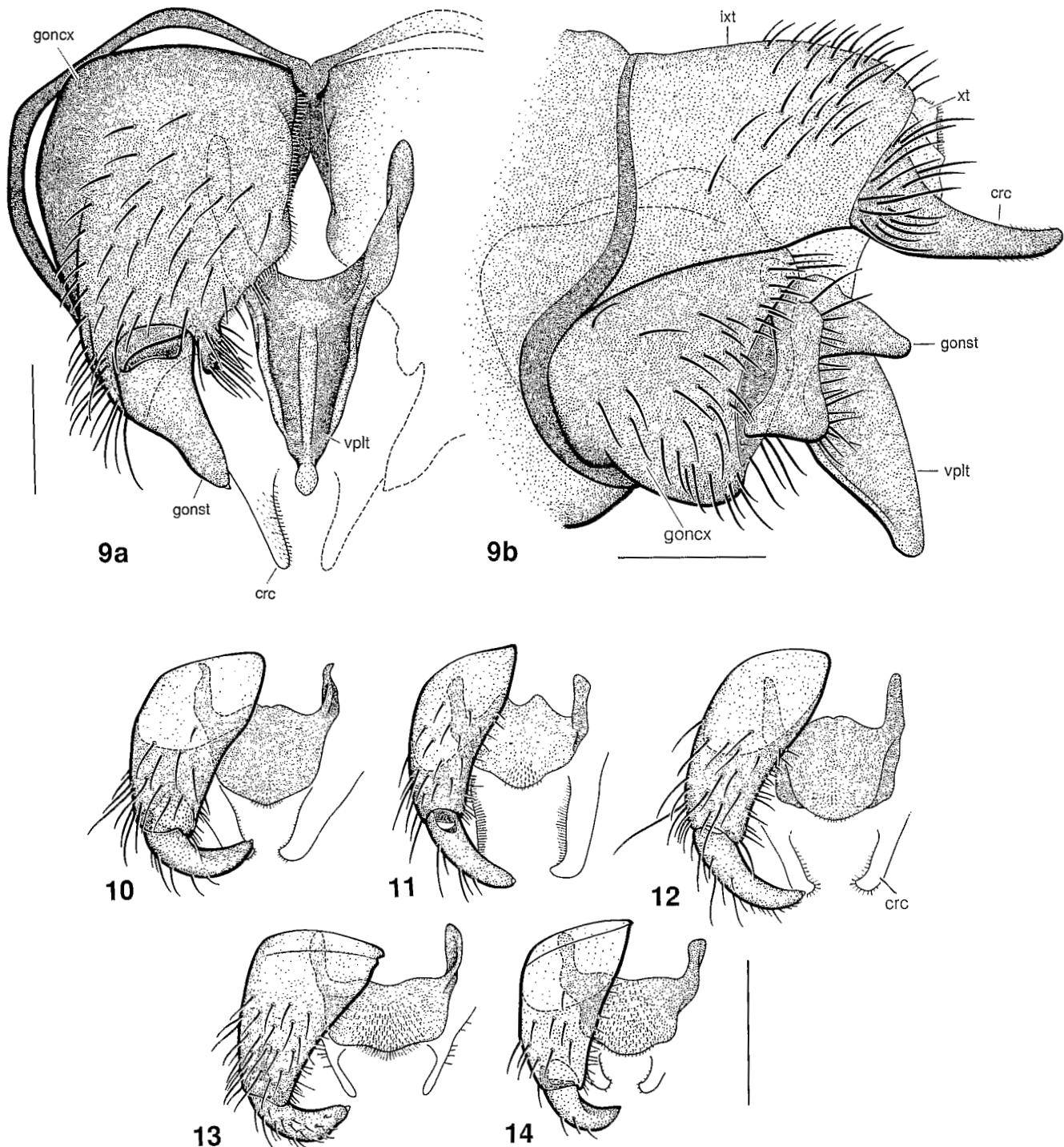
Figs. 2–5. Female genitalia of Marquesan simuliids, ventral view. Insert: Right lateral view. Scale bars = 0.1 mm. Fig. 2. *Simulium adamsoni*. Fig. 3. *S. buissoni*. Fig. 4. *S. gallinum*. Fig. 5. *S. hukaense*. *anlb*, anal lobe; *crc*, cercus; *genfk*, genital fork; *hyp*, hypogynial valve; *spmth*, spermatheca; *xt*, tergite X.



Figs. 6–8. Female genitalia of Marquesan simuliids, ventral view. Insert: Right lateral view. Scale bars = 0.1 mm. Fig. 6. *Simulium mumfordi*. Fig. 7. *S. pichoni*. Fig. 8. *S. rivierei*.



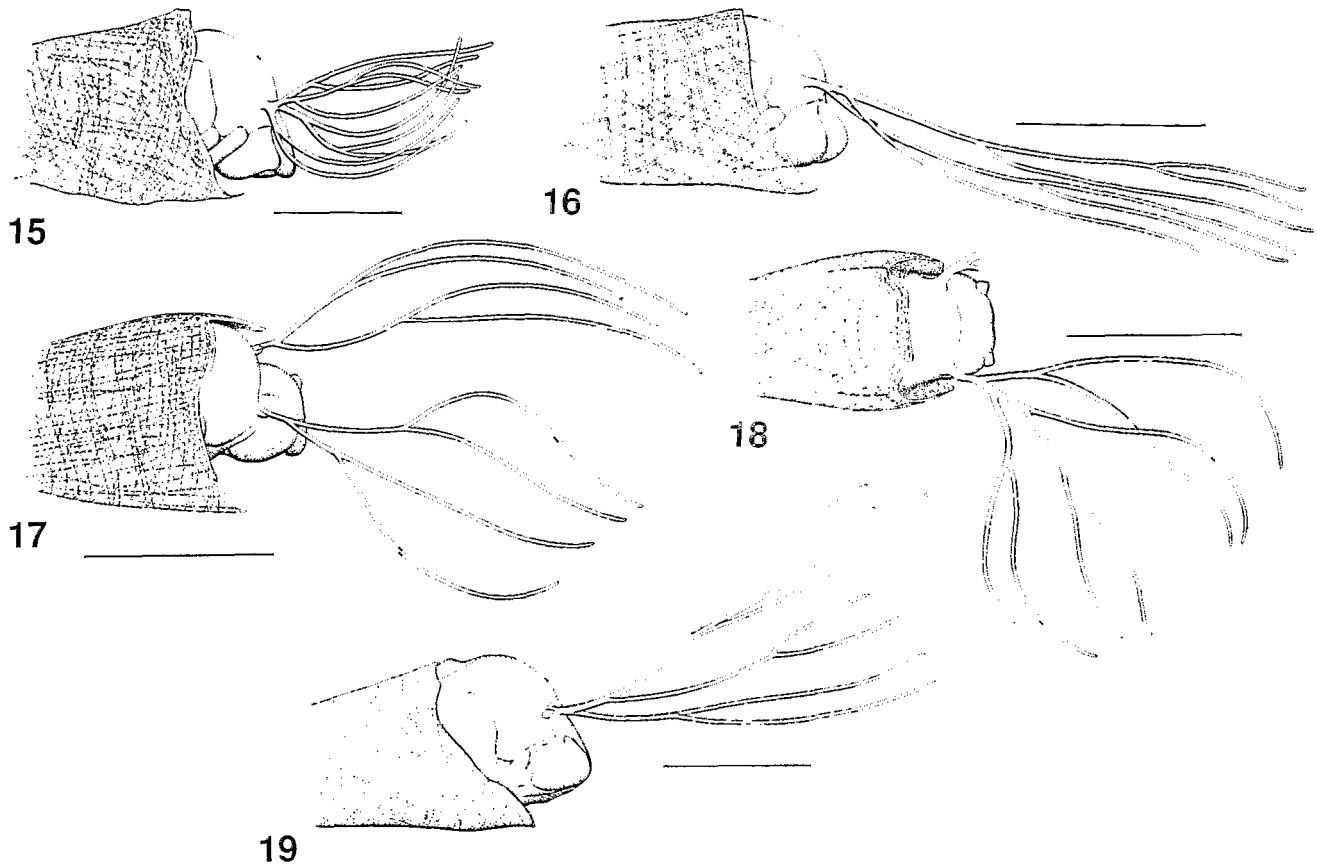
Figs. 9–14. Male genitalia of Marquesan simuliids, ventral view. Scale bars = 0.1 mm. Fig. 9. *Simulium adamsoni*, ventral view (a) and right lateral view (b). Fig. 10. *S. buissoni*. Fig. 11. *S. gallinum*. Fig. 12. *S. hukaense*. Fig. 13. *S. pichoni*. Fig. 14. *S. rivierei*. *crc*, cercus; *goncx*, gonocoxa; *gonst*, gonostylus; *ixt*, tergite IX; *vplt*, ventral plate; *xt*, tergite X.



arms substantial, angular, heavily pigmented, space between shallowly U-shaped, smooth, as wide as deep. Thorax: length 0.88–0.95 mm, width 0.72–0.77 mm; postpronotal lobe slightly paler than scutum; scutum evenly blackish brown, slightly lighter medially of postpronotal lobes; vestiture of sparse even fine pale hairs; scutellum slightly paler than scutum, apical angle 98°, posterolateral edges slightly

convex, vestiture of long coarse hairs; postscutellum concolorous with scutellum; pleuron evenly medium brown. Wing: length 1.3–1.6 mm, maximum width 0.6–0.8 mm; stem vein hair tuft substantial. Halter: knob pale, light brown basally; pedicel concolorous with halter base. Legs: essentially concolorous with pleuron; forelegs evenly brown, but with paler regions on femur and tibia; midlegs distinctly

Figs. 15–19. Pupae of Marquesan simuliids. Scale bars = 1.0 mm. Fig. 15. *Simulium adamsoni*. Fig. 16. *S. buissoni*. Fig. 17. *S. gallinum*. Fig. 18. *S. hukaense*. Fig. 19. *S. uaense*.



evenly brown: hind legs with tarsus distinctly paler. Pretarsal claw with basal tooth 0.5 times length of claw, forming 3° angle with claw tip. Abdomen: generally dark brown with vestiture of fine pale hairs anteriorly and coarse, long black hairs posteriorly; basal fringe of light brown hairs extended to first abdominal segment; tergites I and II narrow and extended across segments, tergite III small, slightly broader than long, yellowish; tergites IV and V as broad as long, yellowish; tergites VI and VII broader than long, darker; tergite VIII continuous across segment, darker; tergites III–VI dull, VII–IX subshiny; sternum very pale anteriorly, darker posteriorly, sternites not visible except sternite VII, which is broad and very dark. Genitalia (Fig. 5): sternite VIII slightly darker medially; cercus broadly rounded; anal lobes extended to 0.6 times length of cercus, with hairs ventromedially; hypogynial valves cone-shaped and rounded apically, extended to 0.5 times length of anal lobe, with very sparse vestiture of coarse black hairs and regularly arrayed microtrichia; median space extended anteriorly to branch of genital fork, widest at 0.6 times length, broadly rounded anteriorly; stem of genital fork narrow, lateral arms fluted with acute angle anterolaterally. Spermatheca ovoid, evenly light brown, no pattern, distinct clear area at spermathecal duct junction.

Adult male (based on one specimen and pharate adults from Vaipae, Ua Huka, and eight specimens from Hane, Ua Huka)

Body: generally blackish brown; length 1.2 mm. Head: width 0.66 mm, depth 0.54 mm. Eyes: upper ommatidia

0.028 mm in diameter, 16 rows up and across eye; lower ommatidia 0.012 mm in diameter, 13 and 16 rows up and across eye, respectively. Clypeus: 0.16 times as wide as head. Antenna: length 0.39 mm; scape and pedicel slightly darker than flagellum. Mouthparts: 0.23 times head depth; mandibles not observed, probably absent; laciniae highly tapered with hairs on distal half; palpus 0.39 mm long, distal article as long as remainder, third article with broad medio-distal angle, sensory vesicle occupying 0.3 times width of article, opening less than 0.3 times width of vesicle, ca. four sensillar sockets visible. Thorax: length 0.85 mm, width 0.65 mm; postpronotum and scutum evenly brownish black; scutum highly convex with even vestiture of fine dark hairs; scutellum slightly paler, apical angle 116° , edges slightly concave, coarse vestiture of long black hairs; postscutellum concolorous with scutum. Wing: length 1.3 mm, maximum width 0.6 mm; stem vein hair tuft substantial. Halter and pedicel pale. Legs: coxae and femora dark brown; vestiture of coarse black hairs; tibiae lighter. Pretarsal claw with ca. 13 grappling hooks dorsally (Fig. 27). Abdomen: mottled brown; vestiture of coarse black hairs; basal fringe of blackish hairs extended to second abdominal segment; tergites very small and yellowish; sternites V and VI distinct and shiny. Genitalia (Fig. 12): gonocoxa 2.4 times as long as basal width; gonostylus approximately 3.0 times as long as wide, narrow, curved, tapered slightly to apex, single blunt terminal spine; ventral plate with median posterior apex hemispherical, vestiture of triangular patch of fine hairs posteriorly, lateral margins flanged to base of anterior arms;

arms parallel, anteromedial edge between arms evenly rounded with small median notch. Cerci: substantial, extended well beyond gonocoxae, vestiture of fine hairs.

Pupa

Length: male 1.4–2.2 mm, female 1.5–1.8 mm. Gill (Fig. 18): length 1.4–1.8 mm; seven filaments (2+3+2) with tendency to splay horizontally; considerable variation in branching pattern and number of filaments, specimens may have normal branching pattern on one side and *S. uaense* pattern (Fig. 19) on the other, or may have seven filaments on one side and eight (2+4+2) on the other. Thorax: cuticle pale yellow; sharply cone-shaped tubercles obvious. Abdomen: sternite III bare, sternite IV with 2 bifurcated spines laterally, sternite V with 4 bifurcated spines medially, sternite VI as for V but spines widely separated, sternite VII with 2 trichoid spines placed laterally; tergite I bare, tergite II with 8 small spines, tergites III and IV with 8 substantial spines, tergite V bare, tergites VI and VII with 6–8 spines; tergite VIII with 10–13 spines, tergite IX with many small spines; terminal spines close together, short, directed posteriorly, not sinuous laterally, pointed apically. Cocoon: closely woven, extended almost completely over thorax dorsally, ventrally to head, posterior floor extended anteriorly only to tips of wing pads, lateroventral margins slightly recurved medially at attachment to substrate.

Larva (based on last-instar larvae with mature gill histoblasts from Vaipae, Ua Huka)

Length 4.1–4.6 mm. Body: generally pale with grayish brown mottling. Head (Fig. 23): width 0.48 mm, length 0.57 mm; distance between fan stem bases 0.27 mm; lateral margins distinctly convex posteriorly; generally evenly light brown, frontoclypeal apotome pale anteriorly, darker posteromedially with figure-8-shaped pattern produced by negative head spots, cuticle on median side of ecdysial line pale, darker lateral of ecdysial line; cervical sclerites small but distinct, not fused to postociput. Stemmata: surrounded by pale area. Antenna: total length 0.38 mm; most of distal article extended beyond stem of labral fan; proximal article light brown, remaining articles pale. Labral fans: 31–34 rays, ca. 0.46 mm in length; a few posterolateral rays shorter than remainder; microtrichia of medial rays up to 2 times longer than ray width, longer microtrichia with five smaller ones decreasing markedly in size to next long one. Hypostoma (Fig. 31): essentially as for *S. buissoni*. Postgenal cleft: as deep as wide, expanded and squarish anteriorly. Postgenal bridge: slightly longer than cleft depth; pale, slightly darker at cleft apex. Head setae normal. Mandible (Fig. 37): essentially as for *S. buissoni*. Maxillary palpus: 3.0 times as long as basal width. Mandibular phragma: extended ventrally to 0.3 times depth of maxilla base. Prothoracic proleg: dorso-lateral sclerite lightly pigmented, not extended full length of distal article. Abdomen: segments I–IV increased very slightly in size posteriorly, expanded sharply to segment V and less so to segment VII, then decreased evenly; posteroventral tubercles small but distinct; posterodorsal cuticle with no obvious cuticular pattern, microtrichia bifurcate. Anal sclerite: posteroventral arms 1.3 times length of dorso-lateral arms, not fused to simple lateral accessory sclerites. Circling of hooks: ca. 74 rows of hooks, 10–14 hooks per row. Anal papillae: simple.

Bionomics

Although *S. hukaense* females have relatively small mouthparts, the laciniae and mandibles are well equipped with teeth for piercing skin. That they blood-feed is substantiated by the fact that some females examined here contained blood meals. One gravid female contained 220+ eggs.

Collection of flying adult males is most unusual in the case of Polynesian black flies; most males are obtained by rearing pupae. Therefore, the collection from "Ua Huka, Hane village, amount du 1^e pont, 4-xii-85, Coll. Y. Séchan," that contains only a large number of males is very interesting. It probably indicates that males of *S. hukaense* form mating swarms.

Comments

Simulium hukaense is generally very similar to *S. buissoni*, but has distinct male genitalia (cf. Figs. 10, 12). Because of the great variation in pupal gill filament branching patterns, further analysis may show that *S. hukaense* is a complex of species.

Other material

In addition to the type we have seen the following:

Nuku Hiva: Taiohae: amount réservoir, 23-III-1972, coll. Y. Séchan (pupae, BPBM).

Ua Huka: Haavei: ?-XII-1985, coll. Y. Séchan (larvae, pupae, ♀♀, ITRMLM); ?-XII-1985, coll. Y. Séchan (pupae, ♀♀, BMNH, BPBM, CNCI, DAC, ITRMLM, MNHP, NZAC, ORSTOM); amount prise d'eau captage, 22-XI-86, coll. Y. Séchan (larvae, pupae, BMNH, BPBM, CNCI, DAC, ITRMLM, MNHP, NZAC, ORSTOM). Vaikivi: 11-VI-1972, coll. Y. Séchan (larvae, pupae, ITRMLM). Vaipae: 2-V-1976, coll. G. Pichon (larvae, pupae, ITRMLM, BPBM). Vaipae: 9-XII-1985, coll. G. Pichon (larvae, pupae, ♂, ♀, ITRMLM, BPBM). Viapae: torrent, 10 m, 15-XI-1981, coll. G. Pichon (larvae, pupae, ITRMLM); 300 m, 15-XI-1981, coll. J.M. Klein (larvae, pupae, ITRMLM). Hane: 16-XI-1981, coll. F. Rivière (larvae, pupae, ♀, ITRMLM); village, amount du 1^e pont, 4-XII-1985, coll. Y. Séchan (larvae, pupae, ♂♂, BMNH, BPBM, CNCI, DAC, ITRMLM, MNHP, NZAC, ORSTOM); ?-XII-85, coll. Y. Séchan (larvae, pupae, ♀♀, BMNH, BPBM, CNCI, DAC, ITRMLM, MNHP, NZAC, ORSTOM).

Ua Pou: Hakahetau: 23-VII-1977, coll. A. Tetuanui (♀♀, ITRMLM); 100 m, 19-XI-1981, coll. F. Rivière (larvae, ITRMLM). Hakamarii: 9-V-1972, coll. Y. Séchan (larvae, pupae, BMNH, BPBM, CNCI, DAC, ITRMLM, MNHP, NZAC, ORSTOM); ?-II-1972, coll. Y. Séchan (larvae, pupae, ITRMLM). Hakatao: 10-V-1972, coll. Y. Séchan (larvae, pupae, ITRMLM). Hakaotu: 9-V-1972, coll. Y. Séchan (larvae, pupae, ITRMLM). Hakamoui: 300 m, 18-XI-1981, coll. F. Rivière (larvae, BMNH).

Klein et al. (1983) recorded *S. hukaense* from the following locations: Nuku Hiva: Taipivai, Hatiheu, Vaionea, Haaume, Aekapa and Uea (Baie Marquisienne); Ua Huka: Toohapu, Hanatete and Haapoa; Ua Pou: Hakahau, Hikeu, Haakuti, Hohoi, and Paumea; Hiva Oa: Atuona, Mataovau, Hanaheke, Tahauku, Punamau, and Hanaiapa.

Simulium (Inseliellum) mumfordi Edwards

Fig. 6

Simulium mumfordi Edwards, 1932: 109.*Simulium mumfordi* Edwards, Klein, Rivière, and Séchan, 1983: 63.*Simulium (Inseliellum) mumfordi* Edwards, Crosskey 1988: 454; 1989: 224. Crosskey and Lowry, 1990: 221.**Types***Holotype*

Pinned female. Labels: "Atuona/ HivaOa/ ix-5-1929", "Marquesas/ Islands", "Mumford &/ Adamson", "on window", "Pacific Entomo-/ logical Survey", "Type (red circle)", "S. mumfordi/ Ed./ F.W. Edwards./det. 1931", "Simulium/ mumfordi/ Edwards/ Holotype/ No. 586 (red)". (BPBM). The holotype is in relatively good condition.

Paratypes

Pinned female. Labels: "Atuona Valley/ HivaOa 300 ft./ vii-6-1929", "Marquesas/ Islands", "Mumford &/ Adamson", "Pacific Entomo-/ logical Survey", "Simulium/ mumfordi/ Edwards/ Paratype (orange)". This specimen, missing one leg and one antenna, was so imbedded in shellac as to be useless. It was depinned, relaxed, and cleared in KOH, and the genitalia were removed for examination. It is now in glycerine in a vial on the pin.

Pinned female. Labels: "Atuona/ HivaOa ix-5-1929", "Marquesas/ Islands", "Mumford &/ Adamson", "on window", "Pacific Entomo-/ logical Survey", "Simulium/ mumfordi/ Edwards/ Paratype (orange)". This specimen was covered with fungi and the abdomen and four legs were missing. It was depinned, relaxed, and cleared in KOH to allow examination of the head and remaining legs. It is now in glycerine in a vial on the pin.

Diagnosis

Female: body dark brown, extremities yellow. Lateral arms of the genital fork narrow and hypogynial valves short and rounded.

Description (based on holotype, and two paratypes in poor condition)*Adult female*

Body: overall dark brown. Length: 1.5 mm (expanded state). Head: evenly very dark brown; width 0.5–0.6 mm, depth 0.4 mm. Eyes: interocular distance 0.05 mm; frontal angle ca. 65°; ommatidia 0.014 mm in diameter, ca. 32 and 33 across and up eye in middle row, respectively. Frons: pollinose with vestiture of laterally directed yellow hairs. Clypeus: pollinose with very sparse long hairs. Antenna: length 0.4 mm; scape and pedicel yellowish brown, flagellomeres darker. Mouthparts: length 0.4 times head depth; mandibles as long as labrum, 3 times as long as wide, medio-distal edge straight with 21 fine teeth; laciniae with ca. 24 retrorse teeth; palpus 0.4 mm long, distal article longer than remainder of palpus, sensory vesicle occupying 0.5 times width of third article, opening 0.5 times width of vesicle, ca. 12 sensilla sockets visible, third article with angular antero-

medial margin with one long sensillum apically. Cibarial pump: proximal arms substantial, angular distally, heavily pigmented, space between U-shaped, smooth, wider than deep. Thorax: length 0.75 mm; width 0.58 mm; postpronotal lobe concolorous with scutum; scutum evenly dark brown; vestiture of very sparse short yellow hairs; scutellum slightly paler than scutum, apical angle 76°, lateral margins straight, sparse vestiture of very long black hairs; postscutellum concolorous with scutellum, sparse vestiture of long black hairs; pleuron lighter than scutum. Wing: length 1.5–1.7 mm, maximum width 0.8 mm; stem vein hair tuft of sparse long brown hairs. Halter: knob brown with pale pedicel. Legs: mainly brown; forelegs evenly brown; mid and hind legs more yellowish; hind femur with yellowish midregion, tibia more evenly brown, tarsus yellowish. Pretarsal claw: basal tooth 0.25 times length of claw, forming 3° angle with claw tip, inner surface of claw straight. Abdomen: generally dark brown with vestiture of sparse long yellow hairs; tergites VI and VII subshiny. Basal fringe of hairs extended to first abdominal segment; tergites squarish, increasing in width on posterior segments (not clear in any specimen). Genitalia (Fig. 6): cercus paler than tergites, broadly rounded apically; anal lobe not extended beyond base of cercus, vestiture of very sparse dark hairs medially; hypogynial valves very short and broadly rounded, vestiture of simple microtrichia laterally, trifid microtrichia medially; median space, extended anteriorly to branch of genital fork, distinctly expanded anteriorly, apex very blunt, widest at 0.5 times depth; stem of genital fork long and thin; lateral arms thin and curved, sharply angular medially, anterolateral angle acute and complex. Spermatheca ovoid, light brown, no pattern, distinct clear area at duct junction.

Male

Unknown.

Pupa

Unknown.

Larva

Unknown.

Bionomics

Nothing is known about this species.

Other material

Only the types were examined.

Edwards (1932) examined material from Hiva Oa: five females from the Atuona Valley, 100–325 ft, and two females from Tahauku, 10-VII-1929 (E.P. Mumford and A.M. Adamson).

Simulium (Inseliellum) pichoni n.sp.

Figs. 7, 13

Types*Holotype*

Female: pinned. Label data: "Simulium pichoni", "Fatu Hiva, Hanavave, /25-xi-83, coll. Y. Séchan", "HOLOTYPE/ No. 15.369" (red) (BPBM). Thorax on pin. Head, abdomen,

and genitalia in glycerine in vial on pin. Left wing and left front leg missing. Right wing slightly damaged.

Paratype

Male: pinned. Head, thorax, and anterior abdomen on pin. Genitalia in glycerine in vial on pin. Missing left midleg. Thorax slightly damaged. Label data: "*Simulium pichoni*", "Fatu Hiva, Hanavave, /25-xi-83. Coll., Y. Séchan", "PARATYPE" (yellow) (BPBM).

Diagnosis

Female: larger; broad head and scutum; generally brown; antennal base distinctly yellow; scutellum distinctly very pale; mid and hind legs generally yellow; genital fork with accessory posteromedial lobe on lateral arms. Male: generally brown; scutellum distinctly very pale; ventral plate wider than deep. Pupa: unknown. Larva: unknown.

Association of the female and male is based on both occurring in the same collection and both possessing the distinctive pale scutellum and a relatively broad thorax.

Description

Adult female

Body: generally brown; total length 2.0 mm. Head: width 0.58 mm, depth 0.41 mm; postociput lighter brown than scutum with vestiture of fine black hairs. Eyes: interocular distance 0.07 mm; frontal angle 77°; ommatidia 0.012 mm in diameter, ca. 28 and 33 across and up eye in middle row, respectively. Frons: slightly paler than vertex, very sparse vestiture of lateral dark hairs. Clypeus: dorsally concolorous with vertex, mottled yellow ventrally, vestiture of short coarse black hairs, with distinct row extended ventrally beyond cone-shaped apex. Postocular hairs fine, black. Antenna: length 0.42 mm; scape, pedicel, and proximal half of first flagellomere distinctly yellowish, remaining flagellomeres light brown. Mouthparts: length 0.4 times head depth; mandibles not examined; laciniae with 27 retrorse teeth; palpus length 0.53 mm, first and second articles distinctly yellow, third article brown with distinct coarse vestiture of long brown hairs, distomedially angular with three hairs, distal article pale, 0.28 mm long, opening of sensory vesicle very obvious, occupying 0.3 times width of third article, opening 0.75 times width of vesicle, ca. 13 sensilla sockets visible. Cibarial pump: proximal arm substantial; space between shallowly U-shaped, smooth, as wide as deep. Thorax: length 0.69 mm, maximum width 0.86 mm; postpronotal lobe paler than scutum; scutum brown, darker anteriorly and laterally, paler posteriorly; even vestiture of short silver hairs; scutellum distinctly paler than scutum, apical angle 120°, posterolateral edges slightly convex, vestiture of essentially a single row of approximately 16 substantial dark hairs; postscutellum concolorous with posterior scutum; pleuron evenly concolorous with posterior scutum. Wing: length 1.25 mm, maximum width 0.55 mm; stem vein hair tuft very substantial with 15+ hairs; hairs on base of costa also substantial. Halter: knob pale with pedicel brown on dorsal aspect. Legs: generally yellowish with distinct brown pattern; forelegs with coxa, trochanter, and tibia brown, distal 1/3 of tibia with yellow ventral region; midlegs and hind legs with coxa, trochanter, and proximal 0.66 of

femur yellow, remainder brown, tibia with yellow median region, tarsomeres brown; pretarsal claw with substantial basal tooth extended 0.5 times length of claw, forming 5° angle with claw tip. Abdomen: segments I and II distinctly pale, remainder darker brown with paler tergites; basal fringe of hairs extended to full length of segment II; tergites II–V decrease rapidly in size posteriorly, remainder broad; sparse vestiture anteriorly, increasing in density and length posteriorly to become a mixture of longer coarse black hairs interspersed with smaller hairs; sternum darker brown with sternites slightly paler. Genitalia (Fig. 7): sternite VIII sharply delimited anteromedially, pigmented area decreasing in width posteriorly; cercus darker than adjacent abdomen, very broadly rounded in lateral view; hypogynial valves short and broadly rounded, vestiture of trifold microtrichia posteriorly, longer microtrichia medially; median space extended anteriorly just to branch in genital fork, sharply rounded anteriorly, widest at 0.5 times depth; stem of genital fork narrow; lateral arms with accessory posteromedial lobe, anterolateral angle acute. Spermatheca ovoid, evenly light brown, no pattern, distinct clear area at spermathecal duct junction.

Adult male

Body: generally brown; length 1.6 mm. Head: width 0.65 mm, depth 0.5 mm. Eyes: upper ommatidia 0.027 mm in diameter, 13 and 9 rows up and across eye, respectively; lower ommatidia 0.011 mm in diameter, 30 and 20 rows up and across eye, respectively; division between upper and lower ommatidia not distinct. Clypeus: 0.19 times as wide as head; light brown dorsally, dark brown ventrolaterally; apex cone-shaped; sparse vestiture of long hairs laterally. Antenna: length 0.4 mm; scape, pedicel, and proximal half of first flagellomere pale, remainder of flagellum light brown. Mouthparts: 0.26 times head depth; mandibles not visible; laciniae pointed with apical hairs; palpus generally very pale with third article brownish, 0.35 mm long, distal article 0.20 mm; sensory vesicle occupying only 0.5 times width of article, opening less than 0.3 times width of vesicle, number of sensillar sockets not examined. Thorax: maximum width 0.58 mm, length 0.78 mm; postpronotum slightly paler than scutum; scutum evenly brown, slightly lighter posteriorly; vestiture of even fine silvery hairs; scutellum distinctly very pale, very sparse vestiture of coarse dark hairs; apical angle 102°, posterolateral edges slightly convex; postscutellum concolorous with posterior scutum. Wing: length 1.8 mm, maximum width 0.6 mm; stem vein hair tuft very distinct; hairs on costa base distinct. Halter: knob very pale; pedicel pale medially, brown laterally. Legs: forelegs generally brown; midleg, coxa, trochanter, and proximal 3/4 of femur pale, distal patch of brown on femur, tibia with pale region, tarsomeres brown; hind legs: coxa pale with brown region, trochanter and 3/4 of femur pale, remainder of femur brown, tibia as for midleg; tarsomeres generally pale; vestiture generally of coarse dark hair; pretarsal claw with 17 or 18 grappling hooks dorsally. Abdomen: generally pale brown; segments I and II very pale, tergum of segments III–V darker brown, remaining segments paler, tergites generally indistinct, but tergite X distinct and longer than wide, vestiture of short brown hairs increasing in length posteriorly; basal fringe of hairs brown, extended to second

abdominal segment: sternum pale, sternites irregular and indistinct. Genitalia (Fig. 13): gonocoxa pale ventrally, brown laterally, 1.6 times as long as basal width, with basal suture terminating at notch medially; gonostylus approximately 2.8 times as long as wide, sharply curved, single blunt terminal spine; ventral plate very broad, posterior margin slightly rounded medially, vestiture not extended anteriorly; broadly rounded at lateral angle; anterior arms slightly shorter than plate length, anteriorly with shallow concave median notch. Cerci: extended to end of gonocoxa, narrow, vestiture of sparse fine hairs.

Pupa

Unknown.

Larva

Unknown.

Specific name

Named to honour Gaston Pichon, ORSTOM, for his extensive collection of Simuliidae from Polynesia.

Bionomics

Nothing is known about this species. However, since the female has well-developed mouthparts and a relatively large palpal sensory vesicle with ca. 13 sensilla, it can be assumed that females are haemophilic.

Other material

No material other than types was examined.

Simulium (Inseliellum) rivierei n.sp.

Figs. 8, 14

Types

Holotype

Female: pinned. Label data: "Simulium rivierei", "FATU HIVA, Vallée de/ Oomoa, 5km. ?-vii-1977/ Coll., A. Tetuanui", "HOLOTYPE/Number 15.370" (red) (BPBM).

Paratypes

Ten females: pinned. Label data: "Simulium rivierei", "FATU HIVA, Vallée de/ Oomoa, 5km. ?-vii-1977/ Coll., A. Tetuanui", "PARATYPE", (yellow) (BMNH, BPBM, CNCI, DAC, NZAC, MNHP, ORSTOM). Two males: pinned. Label data: As for females, but locality data as follows: "HIVA OA, Outukuo Riv/ 300m, 6-xi-1981, /Coll. Y. Séchan" (BMNH, BPBM). Two females: pinned. Label data as for the males (BMNH, MNHP).

Diagnosis

Female: body evenly brown, scutum less convex than *S. gallinum*, appendages generally yellowish. Male: body evenly medium brown; gonocoxa with basal suture; ventral plate broader than deep. Pupa: four filaments, indistinguishable from *S. gallinum*. Larva: indistinguishable from *S. gallinum*.

The designation of *S. rivierei* was made on the basis that the females are more evenly brown and have a less distinctly convex scutum than those of the other species. The males are generally medium brown and have distinct genitalia. How-

ever, at present the pupae and larvae are indistinguishable from those of *S. gallinum*.

Description

Adult female

Body: generally brown; length 1.2–1.5 mm. Head: post-occiput darker brown than scutum; width 0.50–0.55 mm, depth 0.35–0.39 mm. Eyes: interocular distance 0.05 mm; frontal angle 82°; ommatidia 0.012 mm in diameter, approximately 22 and 25 across and up eye in middle row, respectively. Frons: concolorous with vertex; sparse vestiture of very dark hairs. Clypeus: 0.23 times head width; concolorous with vertex; sparse vestiture of lateral short dark hairs; distinct pale cone-shaped apex. Antenna: length 0.45 mm; scape and pedicel pale, flagellomeres yellowish. Mouthparts: length 0.4 times head depth; mandibles as long as labrum, 4 times as long as wide, mediolateral edge straight with 19 teeth; laciniae with 24 retrorse teeth; palpus length 0.45 mm, first and second articles distinctly yellow, third article brown with coarse vestiture of long brown hairs, distal article pale, 0.09 mm long, opening of sensory vesicle very obvious, occupying 0.50 times width of third article, opening 0.75 times width of vesicle, approximately nine sensilla sockets visible. Cibarial pump: as for *S. buissoni*. Thorax: length 0.71–0.78 mm; width 0.58–0.60 mm; post-pronotal lobe distinctly paler at junction with scutum; scutum evenly convex, generally even medium brown, with paler regions medially to postpronotal lobes; vestiture of sparse, even, very fine, pale hairs; scutellum concolorous with scutum, apical angle 102°, posterolateral edges slightly convex when present, vestiture of sparse substantial long dark hairs; postscutellum concolorous with posterior scutum; pleuron evenly lighter than scutum. Wing: length 1.30–1.35 mm, maximum width 0.53–0.55 mm; stem vein hair tuft of 8–10 hairs. Halter: knob and pedicel pale. Legs: generally yellowish; all coxae concolorous with pleuron; trochanter, femur, and tibia of forelegs light brown, tarsus slightly yellow; trochanter and femur of midlegs yellowish, tibia and tarsus browner; all segments of hind legs yellowish. Pre-tarsal claw: basal tooth extended 0.3 times length of claw, forming 5° angle with claw tip. Abdomen: generally dark brown, first three segments paler; sparse vestiture of black hairs; tergites distinct, yellowish and shiny; tergites I and II narrow and extended across segments, tergite III small, tergites III–VI slightly broader than long, tergite VII broader than long, tergite VIII continuous across segment; pleuron concolorous with tergum; sternum pale except on segment VIII, which is concolorous with tergum. Genitalia (Fig. 8): sternite VIII broadly pigmented medially; cercus pale, triangular in lateral view; anal lobe extended to 0.25 times length of cercus; hypogynial valves cone-shaped and rounded, with regularly arrayed microtrichia; median space expanded only slightly to midlength, tapered evenly to sharply rounded apex, not extended to branch of genital fork; stem of genital fork narrow; lateral arms not fluted, anterolateral angle acute. Spermatheca ovoid, evenly light brown, no pattern, distinct clear area at duct junction.

Adult male (based on specimens from Hanavave, Fatu Hiva)

Body: generally light brown; length 1.8 mm. Head: width 0.58 mm, depth 0.45 mm. Eyes: upper ommatidia 0.036 mm

in diameter, 12 and 9 rows up and across eye, respectively; lower ommatidia 0.013 mm in diameter, 34 and 24 rows up and across eye, respectively; division between upper and lower ommatidia distinct. Clypeus: 0.14 times as wide as head; dark brown; apex flat, sparse vestiture of black hairs, arrayed laterally. Antenna: length 0.32 mm; scape and pedicel pale, flagellum light brown. Mouthparts: 0.24 times head depth; mandibles not visible; laciniae tapered to fine point with fine apical hairs; palpus generally pale with third article slightly browner, 0.32 mm long, distal article 0.06 mm; sensory vesicle occupying 0.25 times width of article, opening 0.5 times width of vesicle, ca. four sensillar sockets visible. Thorax: length 0.66 mm, maximum width 0.47 mm; postpronotum paler than scutum, distinctly paler adjacent to scutum; scutum evenly brown, slightly darker anterolaterally, sparse vestiture of small fine silvery hairs; scutellum slightly darker than scutum, apical angle 91°, posterolateral edges slightly convex, vestiture essentially a single row of coarse dark hairs; postscutellum concolorous with scutum; pleuron evenly brown, slightly lighter than scutum. Wing: length 1.8 mm, maximum width 0.6 mm, stem vein hair tuft indistinct. Halter: knob very pale with pedicel light brown. Legs: forelegs evenly light grayish brown, concolorous with antennae; coxa of midlegs concolorous with pleuron, trochanter lighter, remainder of leg darker, but lighter than foreleg; coxa of hind legs as for midlegs, trochanter, femur, and tibia darker, but lighter than those of midlegs, tarsus and tarsomeres lighter. Pretarsal claw: ca. 17 grappling hooks dorsally. Abdomen: generally light grayish brown, pale ventrally; basal fringe of pale hairs extended full length of second abdominal segment; tergites and sternites indistinct, very sparse vestiture of fine grayish hairs. Genitalia (Fig. 14): gonocoxa pale, 1.9 times as long as basal width, with basal suture ending at notch medially; gonostylus approximately 2.5 times as long as wide, single blunt terminal spine; ventral plate with median posterior apex broadly rounded, concave laterally, vestiture of evenly spaced small hairs extended to anterior edge; anterior arms slightly flared laterally, anteromedial edge between arms slightly concave. Cerci: extended to end of gonocoxa, vestiture of extremely fine hairs.

Pupa

At present indistinguishable from *S. gallinum*.

Larva

At present indistinguishable from *S. gallinum*.

Specific name

Named to honour François Rivière, ORSTOM, for his collections of Simuliidae in Polynesia.

Bionomics

Nothing is known about this species. One gravid female from Oomoa contained 300+ eggs.

Other material

In addition to types we examined the following material:

Ua Pou: Hakahetau: 23-VII-1977, coll. A. Tetuanui (♀, ITRMLM).

Hiva Oa: Outukuo: river, 300 m, 6-XI-1981, coll. J.M. Klein (pupae, ♂, ITRMLM); 10 km est de Atuona, Rivière Outukuo, 300 m, 6-XI-1981, coll. Y. Séchan (larvae, ITRMLM, BPBM; pupa, BPBM; ♂, BPBM). Hanaiapa: 900 m, 27-VII-1977, coll. A. Tetuanui (♀, BMNH, BPBM, CNCI, DAC, ITRMLM, MNHP, NZAC).

Fatu Hiva: Hanavave: 25-XI-1983, coll. Y. Séchan (♀, BPBM). Oomoa: valley, 1-VIII-1977, coll. A. Tetuanui (larvae, BMNH, BPBM; ♀, BPBM, ITRMLM, MNHP).

Simulium (Inseliellum) sechani Craig and Fossati, n.sp.
Figs. 24, 32, 38

Types

Holotype

Larva: in alcohol. Label data: "Simulium sechani/ EIAO, Vaituha, /mur cascade, 14-ii-1972, /Coll. Y. Séchan/ HOLOTYPE /#15,368" (BPBM).

Paratypes

Three larvae in alcohol. Label data: "Simulium sechani/ EIAO, Vaituha, mur cascade, /14-ii-1972, Coll. Y. Séchan/ PARATYPE" (BPBM). Two larvae: in alcohol, "Simulium sechani/ EIAO, Vaituha, 120m, /confluence de la rivière-source, /8-vii-1988, Coll. Y Séchan/ PARATYPE" (BPBM, MNHP).

Diagnosis

Larva (last instar): 19–23 labral fan rays, head as wide as long, cervical sclerite essentially absent, postgenal cleft in shape of an inverted V.

Characterization of this species was difficult. Material available from Eiao was that collected by E.P. Mumford and A.M. Adamson in 1929, and from two later collections by Y. Séchan in 1972 and 1988. The quality of preservation was variable. Most larvae appeared to be that of *S. buissoni* but had variable numbers of fan rays. Pupae were of variable size. One had only five gill filaments, not six as is known for *S. buissoni*. The adults were also variable in size. Some were extremely large and had very substantial mouthparts and clypeus. All were too large to be associated with the smaller *S. sechani* larvae, so were assigned to *S. buissoni*; however, they may represent a new species.

Description

Female

Unknown.

Male

Unknown.

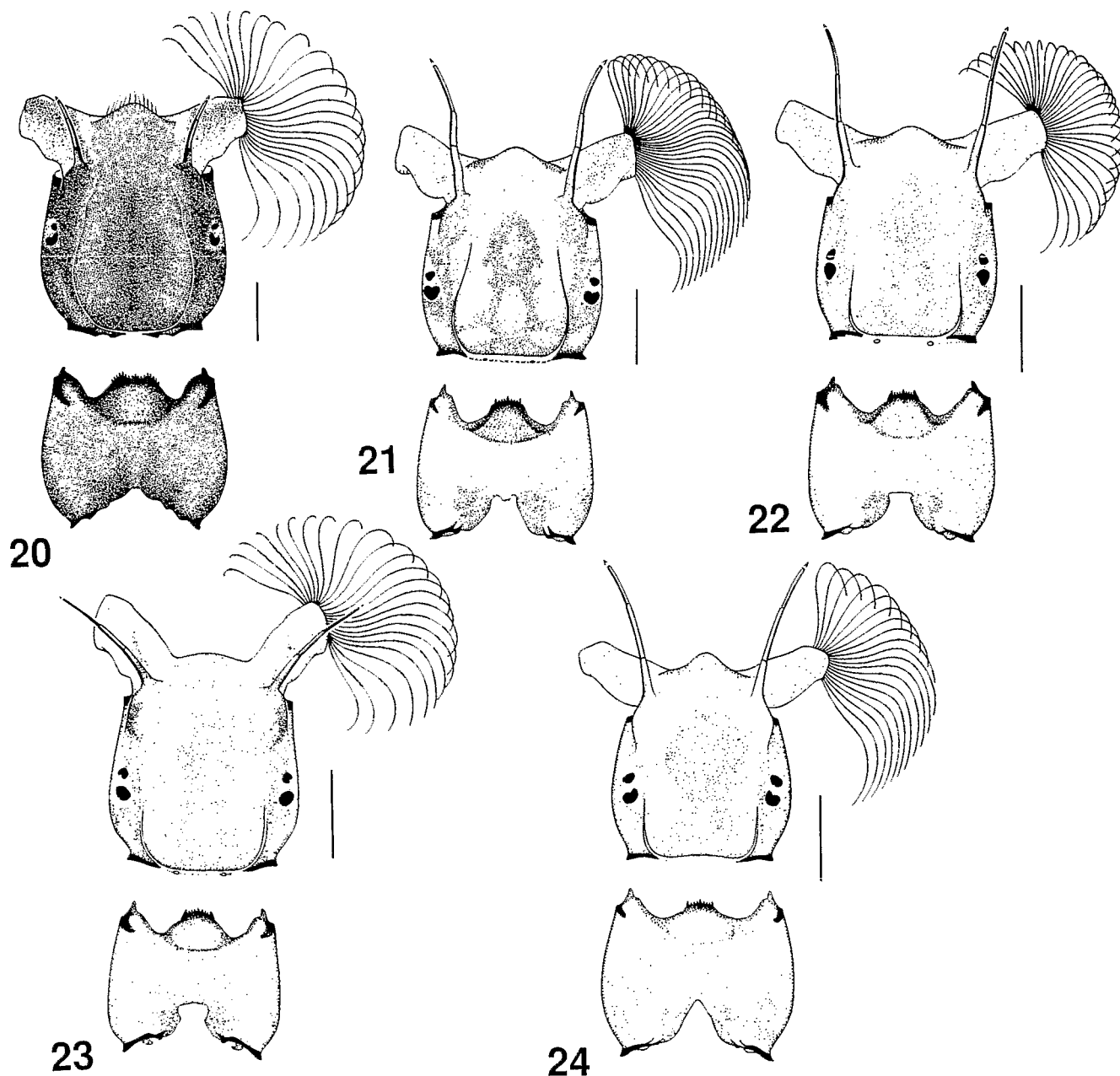
Pupa (from pharate pupae)

Gill filaments and thoracic tubercles as for *S. buissoni*.

Larva

Body: generally pale brown. Length: 3.8–4.7 mm. Head capsule (Fig. 24): very pale, labrum colourless, posterior frontoclypeal apotome very light brown with negative head

Figs. 20–24. Dorsal and ventral views of heads of Marquesan simuliid larvae. Labral fan rays are shown only for approximate numbers: not to scale. Scale bars = 0.25 mm. Fig. 20. *Simulium adamsoni*. Fig. 21. *S. buissoni*. Fig. 22. *S. gallinum*. Fig. 23. *S. hukaense*. Fig. 24. *S. sechani*.



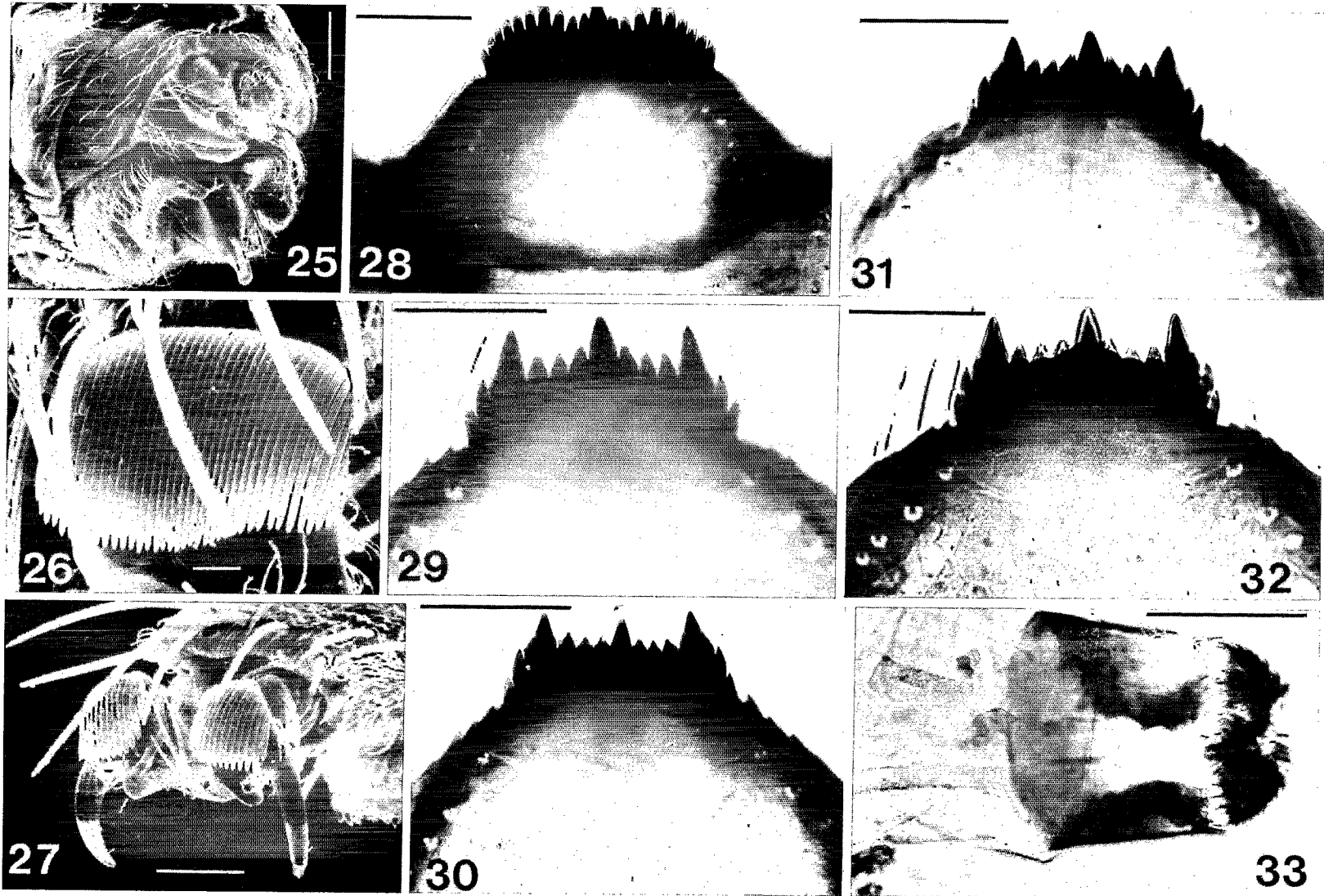
spots; width 0.51–0.54 mm, length 0.50–0.58 mm; distance between fan stem bases 0.29 mm; lateral margins convex, particularly posteriorly; cuticle shiny; cervical sclerites very small and indistinct. Antennae: distal article extending beyond labral fan stem, proximal article darker. Labral fans: with 19–23 rays, ca. 0.5 mm in length; 4 or 5 lateral rays distinctly decreased in length, length of microtrichia of median rays subequal to ray width, pattern of longer microtrichia with 5 or 6 smaller ones decreasing slightly in size to next long one. Hypostoma: essentially as for *S. buissoni* (Fig. 32), but occasionally with 4 sublateral teeth on one side of individual, similarly occasionally with three lateral serrations. Postgenal cleft: as wide as deep, inverted V shape. Postgenal bridge twice as long as cleft. Mandible (Fig. 38):

colourless except for teeth, distance between spinous teeth and serration small; cuticle proximal to sensillum essentially smooth, occasionally with small serrations. Maxilla: colourless except for some distal areas. Prothoracic proleg: dorso-lateral sclerites very lightly pigmented, not extended full length of distal article. Abdomen: shape as for *S. buissoni*: posteroventral tubercles small but distinct. Posterodorsal cuticle smooth. Anal sclerite: posteroventral arms 1.3 times length of anterodorsal arms, not continuous with small distinct lateral accessory sclerites. Circlelet of hooks: ca. 76 rows of hooks, 12–16 hooks per row. Anal papillae: simple.

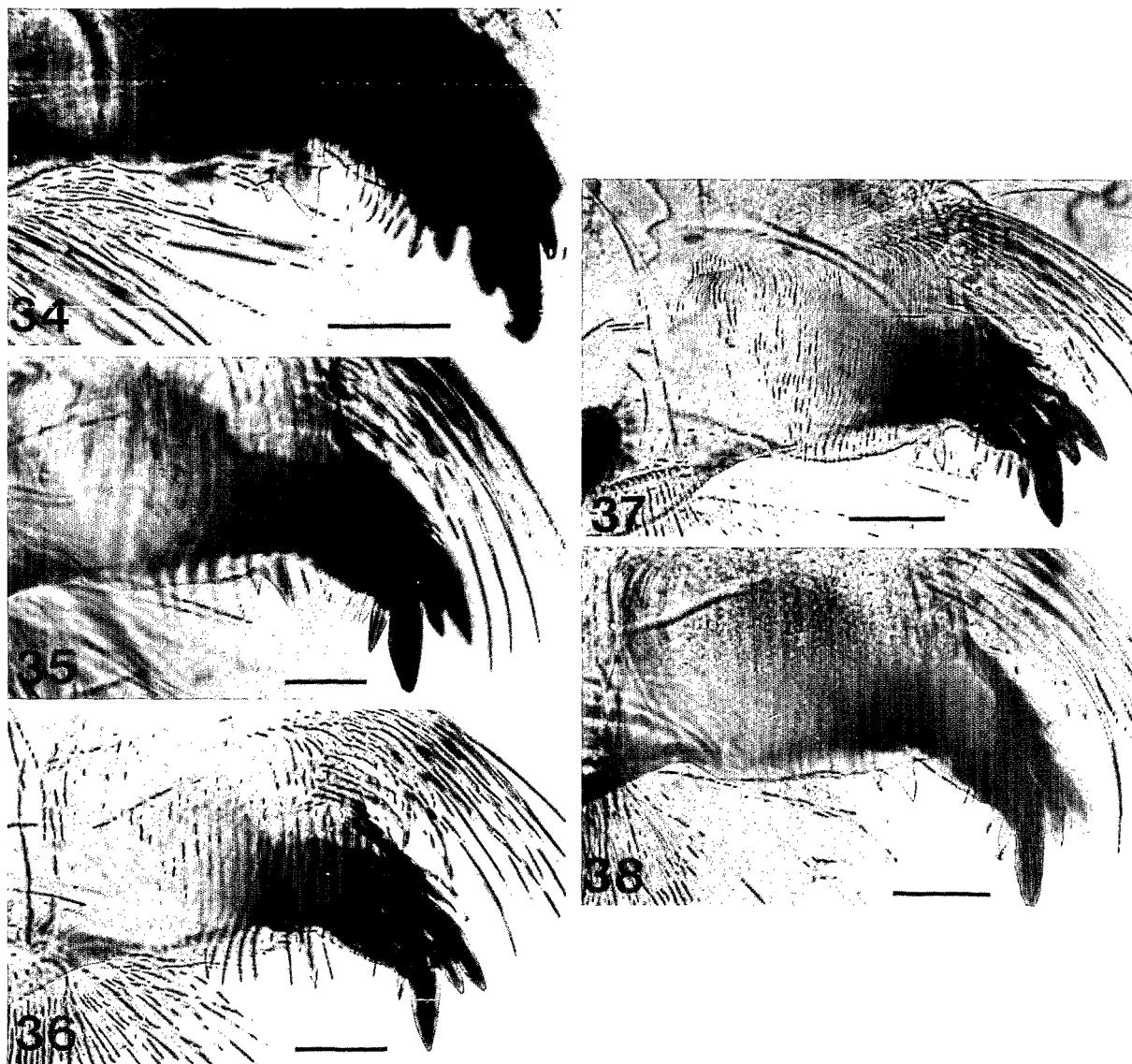
Specific name

Named to honour Yves Séchan, of ORSTOM, Chef de

Fig. 25. *Simulium adamsoni*. Posterolateral view of male genitalia. Scale bar = 0.1 mm. Fig. 26. *S. adamsoni*, grappling hooks on male pretarsal claw. Scale bar = 0.005 mm. Fig. 27. *S. hukaense*, grappling hooks on male pretarsal claw. Scale bar = 0.01 mm. Fig. 28. *S. adamsoni*, larval hypostoma. Fig. 29. *S. buissoni*, larval hypostoma. Fig. 30. *S. gallinum*, larval hypostoma. Fig. 31. *S. hukaense*, larval hypostoma. Fig. 32. *S. sechani*, larval hypostoma. Fig. 33. *S. adamsoni*, larval proleg sclerite. Scale bars for Figs. 28–33: 0.05 mm.



Figs. 34–38. Mandibles of Marquesan simuliid larvae. Scale bars = 0.025 mm. Fig. 34. *Simulium adamsoni*. Fig. 35. *S. buissoni*. Fig. 36. *S. gallinum*. Fig. 37. *S. hukaense*. Fig. 38. *S. sechani*.



l'Unité "Lutte contre les Vecteurs," Institut Territorial de Recherches Médicales Louis Malardé, Papeete, Tahiti, who collected widely in Polynesia and discovered many new simuliid species.

Bionomics

Label data indicate that larvae are found in fast-flowing water.

Comments

It is possible that *S. sechani* represents an ecological variant of *S. buissoni*, because the latter species shows considerable variation in number of labral fan rays. However, at present the combination of characters indicates that it is a valid species.

Other material

No other material was examined beyond the types.

Simulium (Inseliellum) uaense Séchan

Fig. 19

Simulium uaensis Séchan in Klein, Rivière, and Séchan. 1983: 24. (Incorrect gender ending.)

Simulium (Inseliellum) uaense Séchan. Crosskey 1988: 454; 1989: 224.

Types

According to Klein et al. (1983), the holotype was a slide preparation of a last-instar larva from Ua Pou, with the acquisition number "7253," deposited in the Collection d'Entomologie médicale du Centre ORSTOM de Bondy, France. Paratypes were last-instar larvae, 10 from Ua Pou and 1 from Ua Huka. However, the material was not deposited with ORSTOM (Dr. J.P. Hervy, Centre ORSTOM, Montpellier, France, personal communication, 1993) and its whereabouts are unknown. Since there was

only one specimen, a pupa, identifiable as *S. uaense* in the material available for this study, no neotype is designated.

Diagnosis

Female: unknown. Male: unknown. Pupa: seven gill filaments (3+2+2). Larva: see Klein et al. (1983).

Description

Female

Unknown.

Male

Unknown.

Pupa

Length: 2.8 mm female. Gill (Fig. 19): 2.4 mm in length; seven filaments (2+3+2), main stem forked close to base, ventral branch forked at 0.3 times length, dorsal branch forked close to base, three terminal filaments arising from essentially common division. Thorax: cuticle pale yellow; tubercles small, sharply cone-shaped. Abdomen: spines and hooks as for *S. hukaense*. Cocoon rather closely woven, extended only to posterior thorax dorsally, ventrally to head, posterior floor extended anteriorly only to tips of wing pads, ventral margins attached to substrate vertically.

Larva

None examined in this study. Klein et al. (1983) gave some details regarding the hypostoma and mandibles.

Bionomics

Nothing is known.

Comments

Since there is considerable variation in the branching pattern of *S. hukaense*, some specimens having the pupal gill filament branching pattern of *S. uaense* on one side and that of *S. hukaense* on the other, it is possible that *S. uaense* is only a variant of *S. hukaense*. However, until more material is collected and adults are reared, we leave *S. uaense* as a valid species.

Other material

Only one pupae in the material available for this study was identifiable as *S. uaense*:

Ua Huka: Haavei: ?-XII-1985, coll. Y. Séchan (pupa, DAC).

Klein et al. (1987) recorded *S. uaense* from Vaipae (Vaikivi) in Ua Huka, and Hakahetau, Hakatao, Hikeu, and Hakamaï in Ua Pou.

Incertae sedis

Very rare pupae with five and eight gill filaments are left unplaced. Further collections may indicate that these are of species currently known only from adults.

Five filaments: Eiao, Vaituha, mur cascade, 14-II-1972, coll. Y. Séchan (pupa, ITRMLM). Fatua Hiva, Omoa, 26-XI-1983, coll. Y. Séchan (pupa, ITRMLM). Klein et al. (1983) designated similar pupae from Taihae and Vaione,

Nuku Hiva, as "*S. sp. 1.*" Eight filaments: Ua Huka, Haavei, ?-XII-1985, coll. Y. Séchan (four pupae, ITRMLM). Klein et al. (1983) designated similar pupae from Hakapa, Nuku Hiva, as "*S. sp. 2.*"

Concluding remarks

Almost all the known species of *Inseliellum* from Polynesia and the Cook Islands have now been described (Craig and Craig 1986; Craig 1987; this work). Known undescribed species from Polynesia are one and possibly two from Rurutu, Austral Islands, that show relationships to *S. teruamanga* of Rarotonga and to *S. malardei* of the Society Islands, and a number of species from Tahiti that have affinities to *S. tahitiense* and *S. mesodontium*. Since the ages of the Polynesian islands are well established (ORSTOM 1993), when the descriptions of the remaining simuliid species are complete the stage will be set for a phylogenetic and biogeographical analysis of this subgenus of Simuliidae.

Acknowledgments

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