

***Culex verutus*, a new species of the subgenus *Culex*  
(Diptera: Culicidae) from Sierra Leone<sup>1</sup>**

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**ABSTRACT.** The adult, pupal and larval stages of *Culex (Culex) verutus*, n. sp. from Sierra Leone are described and illustrated. The new species is compared to other members of the *guiarti* group.

This paper describes a new species of *Culex* collected in Sierra Leone by Dr. Yiau-Min Huang and Mr. James Pecor during field studies conducted in 1984. The species has been misidentified as *Culex ingrami* Theobald in the past. Anatomical terminology used in this report is that of Harbach and Knight (1980) except as follows: (1) siphon index is calculated using width measured at base, (2) siphon/saddle index replaces saddle/siphon index, (3) **crest** is introduced for the apical part of the aedeagal sclerite, and (4) the part of the lateral plate which articulates with the basal piece is dubbed the **basal articulatory process**. The new terms are illustrated in Figures 1 and 3.

***Culex (Culex) verutus*, New Species**

*Culex ingrami* Edwards sensu Galliard 1932:95; Pajot 1964:1307 (in part, "forme dont les touffes siphonales subventrales sont nombreuses a soies longues et multiples").

*Culex (Culex) ingrami* Edwards sensu Peters 1956:546 (in part, "type c"); (?) Service 1959:1.

**Adult.** A small dark brown species closely resembling *guiarti* Blanchard, *ingrami* Edwards and *pajoti* Ramos and Ribeiro. Characters distinguishing these species are poorly defined except for the structure of the male genitalia.

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<sup>1</sup> The views of the author do not purport to reflect the position of the Department of the Army or the Department of Defense.

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FEMALE. Mainly clothed in dark brown scales; scutal scales pale. *Head*: Antenna dark, length about 1.6 mm; flagellum subplumose, whorls of proximal flagellomeres with about 18 setae; flagellomere 1 pale, lengthened, nearly twice as long as flagellomere 2; pedicel yellowish brown, mesal surface darker with some inconspicuous pale setae. Proboscis entirely dark-scaled; length about 1.5 mm. Maxillary palpus entirely dark-scaled; length about 0.28 mm, approximately 0.18 length of proboscis. Forked scales of vertex brown; falcate scales whitish, rather coarse; lateral spatulate scales white or nearly so. *Thorax*: Scutum brown with sparse covering of fine, pale yellowish-brown scales, scales whitish on anterior promontory; integument of prescutellar area, supraalar area and scutellum faded (whitish); scutal setae prominent, brown. Ante- and postpronota brown, former without scales, latter with fine pale scales scattered on upper margin; postpronotum with 5-7 setae on posterodorsal margin. Pleura with 2 indefinite longitudinal brown bands, upper band extends across postspiracular area, prealar area and upper area of mesanepimeron, lower band extends across midregion of mesokatepisternum and lower area of mesanepimeron, other areas of pleura faded (whitish); pleural scales pale, nearly colorless, confined to small inconspicuous patches on upper area of proepisternum, upper and lower areas of mesokatepisternum and anterior area of mesanepimeron, other areas devoid of scales; pleural setae yellowish to brown -- 4 or 5 upper proepisternal, 6-8 prealar, 4 or 5 upper mesokatepisternal, 5-8 lower mesepimeral, 4-6 upper mesepimeral and 1 or 2 lower mesepimeral. *Wing*: Length about 3.0 mm; cell  $R_2$  2.9-3.6 of vein  $R_{2+3}$ ; cell  $M_1$  0.8-0.9 of cell  $R_2$ ; furcation of veins  $R_{2+3}$  and  $M_{1+2}$  at same level; scales entirely dark. *Halter*: Scabellum pale, pedicel and capitellum darker. *Legs*: Coxae pale (white or nearly so), forecoxa slightly darker; anterior surface of forecoxa dark-scaled with whitish scales at base; mid- and hindcoxae with longitudinal row of inconspicuous, nearly colorless scales. Trochanters white-scaled. Femora without knee spots; fore- and midfemora mainly dark-scaled, posterior surface of forefemur with broad longitudinal stripe of white scales, posteroventral surface of midfemur white-scaled with dark scaling of dorsal surface expanded over posterior surface toward apex; hindfemur white-scaled with dorsal dark stripe abruptly expanded over whole of anterior and posterior surfaces on apical 0.1. Fore- and midtibiae mainly dark-scaled, whitish-scaled posteriorly; hindtibia entirely dark-scaled. Tarsi dark-scaled; tarsomeres 1 and 2 of fore- and midlegs with paler scaling on posteroventral surface. Pulvilli pale. Ungues normal, dark. *Abdomen*: Tergum I with median posterior patch of dark scales; terga II-VIII unbanded, dark-scaled with rather small but distinct basolateral white spots. Sterna II-VII with broad apical dark bands, posterior sterna mainly dark-scaled; sternum

VIII with lateral patches of white scales only.

**MALE.** Like female except for following sexual differences. *Head:* Antenna plumose; length about 1.5 mm. Proboscis with false joint about 0.6 from base. Maxillary palpus entirely dark; length about 2.2 mm, exceeding proboscis length by length of palpomere 5. *Thorax:* Proepisternum with 7 or 8 setae in upper area. *Wing:* Shorter, length about 2.7 mm; cell  $R_2$  about 2.0 length of vein  $R_{2+3}$ . *Abdomen:* Basolateral spots larger, bilateral pairs nearly joined on more posterior terga. *Genitalia* (Figs. 1,3): Ninth tergal lobe small, with irregular row of 4-6 setae. Gonocoxite normal; ventrolateral surface with normal complement of large setae, mesal surface with 5 rows of small setae extending from base to level of subapical lobe, lateral surface with patch of about 15 moderately long slender setae; subapical lobe undivided; setae *a-c* stout, rodlike, *a* shorter than *b* and *c*, blunt at tip, *b* and *c* hooked at tip; 3 setae in group *d-e*, *d* duplicated, slightly flattened and hooked at tip, *e* flat and broad, slightly asymmetrical, resembling *f*, *f* larger than *e*; seta *g* fusiform, very slightly asymmetrical; seta *h* slightly flattened, evenly tapered and curved, about as long as *g*. Gonostylus evenly curved and tapered, with 2 small setae before tip; gonostylar claw flattened, broadened apically. Phallosome with lateral plates slightly longer than aedeagal sclerites, aedeagal sclerite broad with rounded crest (lateral view); lateral plate with laterally-curved tooth (= modified ventral arm) arising near middle of mesal surface and projecting only slightly beyond caudal margin, caudal margin ridgelike with blunt dorsal process, dorsal process directed slightly laterad; midregion of lateral plate thickened, thickened area continuous with well developed basal articulatory process (articulates with basal piece), base of this process continuous with dorsal aedeagal bridge; dorsal arm short and pointed, arising ventrad of usual position near dorsal aedeagal bridge, borne at base of tooth; aedeagal sclerites connected near midlength by normally-developed ventral aedeagal bridge. Proctiger distinct; paraproct well expanded onto ventral surface of proctiger, with long, slender, ventrally-curved basal lateral arm and prominent lateral flange extending from basal part of basal lateral arm to point near base of crown, also with small bumpy ridge developed ventrally at apex; crown with dense covering of short spinelike spicules, some shorter and flatter laterally. Cercal sclerite elongate, broadest at caudal end, tapering anteriorly; 3-5 cercal setae. Tergum X elongate, slightly curved.

**Pupa** (Fig. 1). Placement and character of setae as figured; range and modal number of branches provided in Table 1. *Cephalothorax:* Lightly tanned, legs darker; metanotum covered with conical vesicles. Seta 3-CT usually triple (2-4), with branches of different lengths; 4-CT normally double (2,3); 6-CT

usually multiple (2-7); 7,9,11-CT double, 7-CT rarely single; 8,12-CT commonly with 4 or 5 branches, 8-CT infrequently triple, 12-CT infrequently with 3 or 6 branches; alveolus of 13-CT present. *Trumpet*: Lightly to moderately tanned, tracheoid area darker; long and slender, slightly bent at tracheoid area; index 8.6-10.5, mean 9.3; pinna short, about 0.1 of trumpet length. *Abdomen*: Lightly tanned, terga I and II with conical vesicles, vesicles most prominent on central area of tergum I and median posterior area of tergum II; length 2.2-2.4 mm. Seta 1-II broomlike, with 35-60 branches; 1-III-VII multiple, number of branches progressively fewer on each succeeding posterior segment, 1-III often with 11-13 branches (8-14), 1-VII commonly with 4 branches (3,4); 3-I-III,V,VI double, 3-IV,VII multiple, 3-IV often with 7 or 8 branches (5-9), 3-VII normally with 3 or 4 branches (3-5); 5-II,III frequently with 7 branches (5-9), 5-IV-VI strong, at least 1.5 length of following tergum, 5-IV usually with 3 or 4 branches (3-5), 5-V,VI normally double (2-4 and 2,3 respectively); 6-III-VI moderately developed, usually with 4 or 5 branches, 6-V,VI infrequently with 3 or 6 branches; 9-I forked, often triple (2-5). Posterolateral angle of tergum VIII subacute. *Genital lobe*: Lightly tanned; length about 0.14 mm in female, about 0.29 mm in male. *Paddle*: Lightly tanned, midrib hardly darker; buttress not well developed; midrib complete to near posterior margin; margins smooth; length 0.59-0.71 mm, mean 0.65 mm, width 0.43-0.51 mm, mean 0.47 mm, index about 1.4.

**Larva** (Fig. 2). Placement and character of setae as figured; range and modal number of branches given in Table 2. *Head*: Wider than long; length 0.57-0.69 mm, mean 0.63 mm; width 0.94-1.07 mm, mean 1.01 mm; lightly tanned, posterior part of dorsal apotome and lateralia sometimes darker. Median labral plate narrow, slightly concave between insertions of seta 1-C. Labiogula longer than broad, broader posteriorly; hypostomal suture not extended from posterior pit to collar. Collar well developed, moderately to heavily tanned. Dorsomentum usually with 7 teeth on either side of median tooth, sometimes with 5 or 6 on either side. Seta 1-C moderately tanned, rather stout, about twice diameter of setae 5,6-C, length 0.06-0.10 mm; 2-C rudimentary; 5,6-C double (5-C single in one specimen); 7-C frequently with 7 branches (5-10); 10-C usually triple (2-4); 11-C rather small, usually triple (2-4); 12-C frequently with 6 or 7 branches (3-9); 13-C normally with 4 branches, occasionally triple; 14-C usually double with strongly divergent branches, occasionally triple. *Antenna*: Length 0.52-0.61 mm, mean 0.57 mm, about equal to length of head; lightly tanned, slightly darker than head, basal rim and distal part darker; proximal part with prominent aciculae on dorsal and lateral surfaces, distal part with some shorter, stouter spicules on lateral surface. Seta 1-A with 21-34 branches; 2,3-A long, arising very near apex; 4-A nearly length of 2,3-A. *Thorax*: Integument hyaline; essentially smooth, with rows of minute vesicles; tubercles of

all large setae moderately tanned; setae 1-3-P and 9-12-P,M,T on common tubercles, Seta 3-P short, about 0.5 length of 1,2-P; 4-P usually single, occasionally double; 7-P normally triple, sometimes double, infrequently with 4 branches; 11-P with 4-6 branches, more often with 5. Seta 1-M usually double or triple, sometimes single, about same length as 2-M; 2-M usually double or triple, infrequently with 4 branches; 3-M usually single, seldom double; 4-M usually double, seldom single, nearly as long as 3-M. Seta 1-T very short, about 0.20 length of 2-T, normally single, rarely double; 2-T usually triple, occasionally double; 12-T normally double (1-4). *Abdomen*: Integument same as thorax, segment VIII with tiny spicules around comb and small sclerite on middle of dorsal surface. Seta 3-I usually triple (2-4), 3-II-IV usually double (1-3), 3-V,VI single, 3-VII most often with 4 branches (2-6); 6-I-VI commonly triple, 6-I,VI occasionally with 4 branches, 6-II more variable than the others (2-5), 6-III-V almost always triple; 7-I normally single, rarely double; 1-III-VI multiple (4-8), length gradually increasing on each succeeding posterior segment, 1-III shorter than 0.5 length of segment, 1-VI longer than 0.5 length of segment, 1-III-V usually with 4 or 5 branches, 1-VI most often with 5 or 6 branches. *Segment VIII*: Comb with 42-58 scales, mean 48; scales short, evenly fringed on sides and apex (apical fringe stronger), arranged in 4 irregular rows; seta 3-VIII usually with 10 branches, occasionally with 9, rarely with 11. *Siphon*: Rather long and narrow, broadest at base, tapered to near end of pecten, slightly expanded at apex, index 6.95-8.40 (width measured at base), mean 7.86; lightly tanned, basal rim and apical area darker. Pecten on basal 0.33 of siphon, ending near level of seta 1a-S, with 8-16 spines (frequently 13 or 14), larger spines rather stout, straight and with 1 or 2 pointed denticles near midlength on ventral side; pecten followed by row of 4-7 unpaired simple spines extending to near tip of siphon (Fig. 2), spines of opposite sides often converge distally into a single posterior line (Fig. 3). Seta 1-S in 5 posterolateral pairs (10 elements), member of 1 pair often absent on 1 side of siphon (9 elements present), length 1.4-1.6 width of siphon at point of insertion. Posterior median process of spiracular apparatus uniquely developed, arising from posterior margin of spiracular apodeme as a strong, erect spine (Fig. 3). *Segment X*: Saddle complete, posterolateral margin produced caudad in middle, with tiny spicules on lateral areas at posterior end, lightly tanned; length 0.30-0.35 mm, mean 0.32 mm, siphon/saddle index 4.21-5.34, mean 5.01. Seta 1-X usually double or triple, seldom with 4 branches; 2-X most often double, frequently triple, occasionally with 4 branches; 4-X in 6 pairs, all borne on grid. Anal papillae acutely tapered, dorsal pair slightly longer than ventral pair, both longer than saddle.

**Type data.** Type series comprised of 2 males, 4 females, 6 pupal exuviae, 5 larval exuviae and 4 fourth-instar larvae.

Holotype male (specimen number 164-13) with associated larval and pupal exuviae and genitalia on slides: SIERRA LEONE, Southern Province, Moyamba District, Kasawe Forest Reserve, May 29, 1984, Coll. Huang and Pecor, Systematics of *Aedes* Mosquitoes Project (SAMP) accession number 1093, collected as larva from ground pool on stream bed in partial shade in forest. Paratypes with same data as holotype: 1 female with pupal exuviae (specimen number 158-102), 3 females and 1 male with larval and pupal exuviae (specimen numbers 164-10, 164-11, 164-12, 164-14) and 4 fourth-instar larvae (specimen numbers 158a, b; 164a, b). Male genitalia of specimen number 164-14 dissected and mounted on slide. Deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

**Discussion.** *Culex verutus* belongs to a small group of species characterized by the subplumose antenna and lengthened first flagellomere of the female. This group includes *guiarti* Blanchard, *grahamii* Theobald, *ingrami* Edwards, *schwetzi* Edwards, *weschei* Edwards and *pajoti* Ramos and Ribeiro. Based on both adult and larval characters, *verutus* is most closely related to *ingrami* and *pajoti*.

*Culex ingrami* and *pajoti* are remarkably similar and I would regard them as the same species except I have not examined the type of *ingrami*. I have examined paratype material of *pajoti* (Fig. 3) and have compared it to the published descriptions and illustrations of type material of *ingrami* (Edwards 1916; Macfie and Ingram 1916). The degree of difference reported by Ramos and Ribeiro (1981) seems hardly sufficient to warrant specific status for *pajoti*.

The present concept of *ingrami* includes two forms, the nominotypical form (Edwards 1916; Macfie and Ingram 1916, 1923; "type a" of Peters 1956; "forme dont les touffes siphonales subventrales sont composees de sois courtes" of Pajot 1964) and the so-called "Kampala" form (Hopkins 1931; "type b" of Peters 1956). If these forms ever are recognized as distinct species, then *pajoti* would become the junior synonym of the nominotypical form and the "Kampala" form would require naming.

The adult of *verutus* differs from that of *ingrami* and *pajoti* in having a small, inconspicuous patch of anterior mesepimeral scales and in several features of the male genitalia, including the presence of two additional setae in group *d-e* of the subapical lobe, the differently placed tooth of the lateral plate and the more strongly developed basal lateral arm of the paraproct (cf. figures 1 and 3). In the larval stage, *verutus* is readily separated from other members of the *guiarti* group by the uniquely developed posterior median process of the spiracular apparatus (Fig. 3). The larva which Hopkins (1952) attributes to

*perfidiosus* Edwards bears a similarly developed posterior median process, but this larva is easily separated from *verutus* by the absence of siphonal spines beyond the pecten. The pupae of *verutus*, *ingrami* and *pajoti* appear to be indistinguishable.

*Culex verutus* traces to *philipi* Edwards in Edwards' (1941) key to the Ethiopian species of the subgenus *Culex*. However, *verutus* is easily distinguished from *philipi* by the subplumose antenna of the female and the different genitalia of the male. The larva of *philipi* has a completely different siphon. The larva of *verutus* goes to *ingrami* in Hopkins' (1952) key to the *Culex* larvae of the Ethiopian Region. In the modified version of this key prepared by Ramos and Ribeiro (1981), it goes to *pajoti*. The new species is immediately separated from both *ingrami* and *pajoti* by the character of the siphon mentioned above and illustrated in Fig. 3.

During this study I examined five larvae labelled *ingrami* in the NMNH which are actually specimens of *verutus*. One larva is from Kpain, Liberia; the others are from Bouake, Ivory Coast. They differ from the type specimens in having a slightly shorter siphon. Siphon indices for these specimens varied from 6.29 to 6.50. Two of the specimens had 18 pecten spines on one side of the siphon.

The fanciful yet descriptive name for the new species was chosen for the appearance of the posterior median process borne prominently at the tip of the siphon. The Latin name *verutus* means "armed with a dart or javelin."

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**Abbreviations Used in Figures**

a-h	= setae <i>a-h</i> of subapical lobe
A	= antenna
bap	= basal articulatory process of lateral plate
bla	= basal lateral arm of paraproct
c	= crest of aedeagus
C	= cranium
CS	= comb scale
CT	= cephalothorax
Dm	= dorsomentum
doa	= dorsal arm of lateral plate
dp	= dorsal process of lateral plate
M	= mesothorax
p	= puncture
P	= paddle; prothorax
PMPc	= posterior median process of spiracular apparatus
PS	= pecten spine
S	= siphon
SL	= subapical lobe of gonocoxite
t	= tooth of lateral plate
T	= metathorax
I-X	= abdominal segments

Table 1. Number of branches for pupal setae of *Culex (Culex) verutus*.<sup>a</sup>

Seta No.	Cephalothorax CT	Abdominal Segments									Paddle P
		I	II	III	IV	V	VI	VII	VIII	IX	
0	-	-	1	1	1	1,2(1)	1,2(1)	1	1	-	-
1	3-5(4) <sup>b</sup>	63-116(86)35-60(48)	8-14(12)	7-15(12)	4-8(6)	3-6(5)	3,4(4)	-	-	1	1
2	3-5(5)	1,2(1)	1	1	1	1	1	-	-	-	1
3	2-4(3)	2	2	5-9(7)	2	2	3-5(4)	-	-	-	-
4	2,3(2)	5-9(7)	3-7(6)	4-8(6)	2-5(4)	3,4(4)	2	2	-	-	-
5	3-7(5)	1-7(3)	5-9(7)	3-5(4)	2-4(2)	2,3(2)	2,3(2)	-	-	-	-
6	2-7(4)	1	1	4,5(5)	4,5(4)	3-6(5)	5-7(6)	-	-	-	-
7	1,2(2)	1-3(2)	1,2(2)	4-6(6)	3-6(4)	5-8(8)	1	1	-	-	-
8	3-5(5)	-	-	2-6(4)	2-4(3)	1-3(3)	3-5(4)	3-5(4)	-	-	-
9	2	2-5(3)	1,2(1)	1	1	1	1	3-5(3)	6-9(9)	-	-
10	3-7(5)	- <sup>c</sup>	-	2	2	1	1	1	-	-	-
11	2	1,2(2)	-	1	1	1	1,2(1)	1-4(2)	-	-	-
12	3-6(4)	-	-	-	-	-	-	-	-	-	-
13	- <sup>c</sup>	-	-	-	-	-	-	-	-	-	-
14	-	-	-	1	1	1	1	1	1,2(1)	-	-

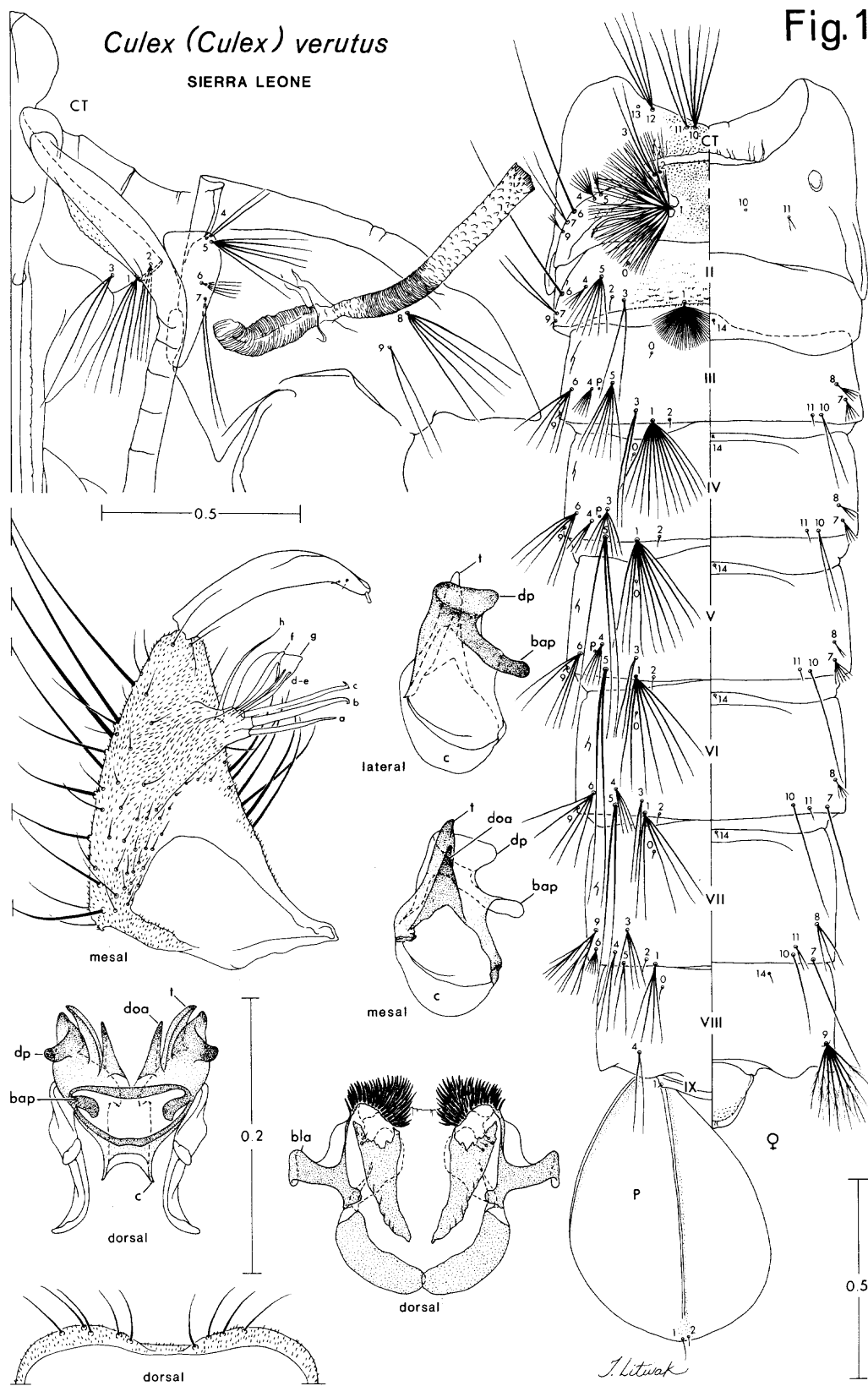
<sup>a</sup> Based on counts made on the holotype and 5 paratypes.<sup>b</sup> Range (mode).<sup>c</sup> Alveolus only.

**Table 2.** Number of branches for fourth-instar larval setae of *Culex (Culex) verutus*.<sup>a</sup>

Seta No.	Head C	Thorax		Abdominal Segments									
		P	M	I	II	III	IV	V	VI	VII	VIII	X	
0	1	13-24(18) <sup>b</sup>	-	-	1	1	1	1	1	1	1	1	-
1	1	1-3(2)	1,2(1)	2-4(3)	1,2(2)	4-7(4)	4-6(5)	4-8(5)	4-7(5)	6-9(7)	5-8(6)	2-4(3)	
2	1	2-4(2)	2,3(3)	1,2(1)	1	1	1	1	1	1	1	2-4(2)	
3	1	1,2(1)	3-8(5)	2-4(3)	1-3(2)	2,3(2)	1,2(2)	1	1	2-6(4)	9-11(10)	1	
4	1	1,2(2)	3-6(3)	8-17(12)	4-8(6)	2-4(2)	1-3(2)	4-7(5)	2,3(2)	1	1	2-10(9)	
5	1,2(2)	1	1,2(1)	2-8(6)	1-3(2)	1-3(2)	1-3(2)	1-3(2)	2-5(4)	2-4(2)	2-5(4)	-	
6	2	1	1	3,4(3)	2-5(3)	2,3(3)	3	3,4(3)	2-4(3)	13-21(16)	-	-	
7	5-10(7)	2-4(3)	1	1,2(1)	4-9(6)	5-11(7)	6-10(9)	5-8(6)	1,2(1)	1	1a-S, 2-6(3)		
8	4-7(5)	1,2(2)	4-6(4)	-	1,2(1)	2	2	2,3(2)	3-6(4)	4-6(5)	1b-S, 2-5(3)		
9	2-9(5)	1	3-6(5)	2-4(3)	1	1	1	1	1,2(1)	2-4(2)	1c-S, 2-5(2)		
10	2-4(3)	1	1	1,2(1)	1,2(1)	1	1	1	1	1	1d-S, 2-4(2)		
11	2-4(3)	4-6(5)	2,3(2)	3-8(4)	1-5(2)	1-3(2)	2-4(2)	1-3(2)	1-3(2)	1-3(2)	1e-S, 1-3(2)		
12	3-9(6)	1	1	2-5(3)	2	1-4(2)	1-3(2)	1,2(1)	1	1	-		
13	3,4(4)	-	18-30(23)	1-3(2)	17-34(26)	3-5(3)	3-5(4)	4,5(4)	20-49(36)	2-6(3)	-		
14	2,3(2)	1,2(2)	12-30(20)	-	1	1	1	1	1	1	-		
15	4-7(6)	-	-	-	-	-	-	-	-	-	-		

<sup>a</sup> Based on counts made on the holotype and 8 paratypes.

<sup>b</sup> Range (mode).



*Culex (Culex) verutus*  
SIERRA LEONE

Fig.2

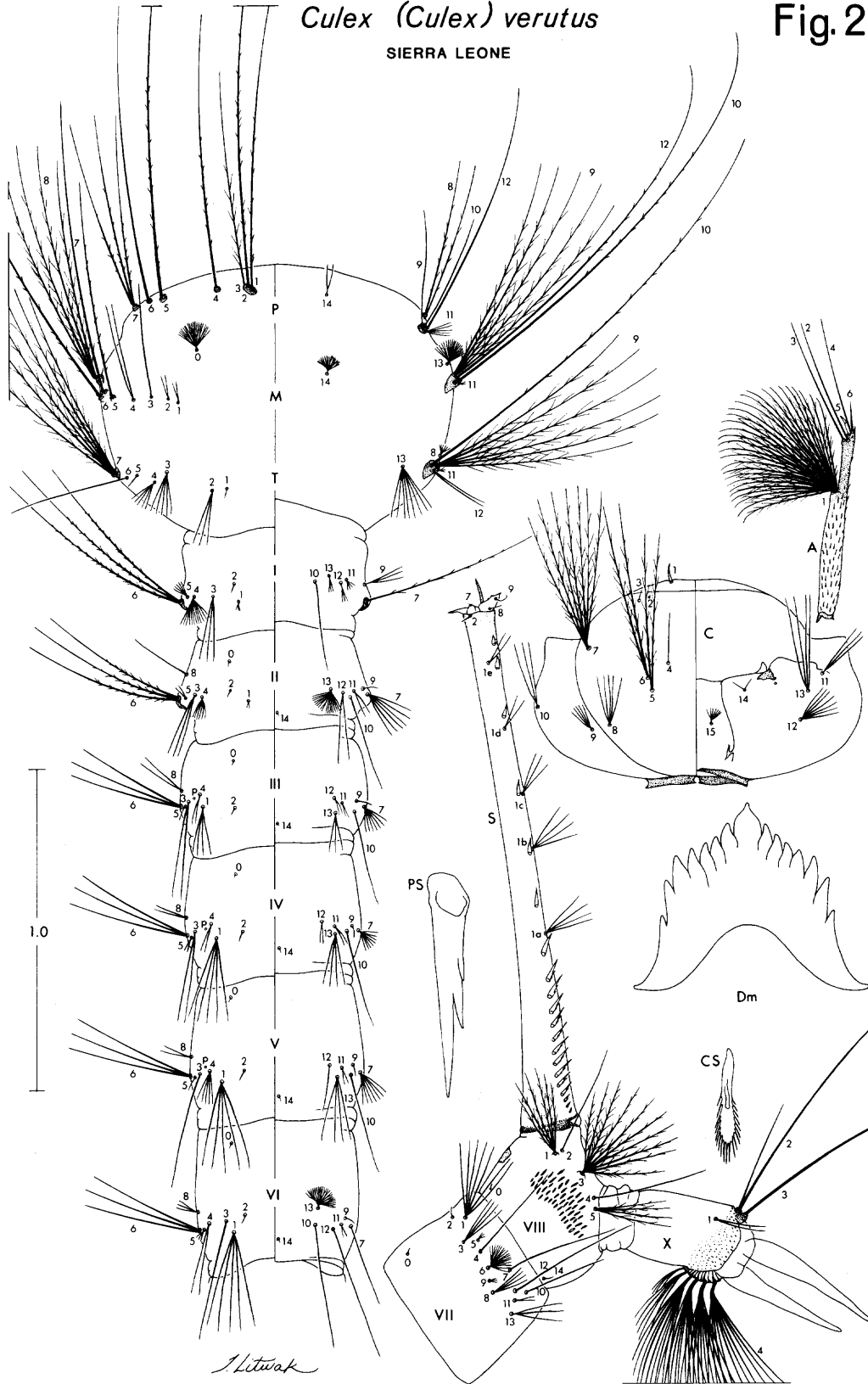


Fig.3

