

TWO SPECIES PREVIOUSLY CONFUSED UNDER THE CONCEPT OF *SABETHES TARSOPUS* IN CENTRAL AMERICA (DIPTERA: CULICIDAE)¹

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ABSTRACT. *Sabethes gymnothorax* new species is separated from *Sabethes tarsopus*, and the adults, fourth-instar larva and pupa of both species are described and illustrated. Bionomic and taxonomic information is provided.

INTRODUCTION

Sabethes tarsopus Dyar and Knab represents a common problem in the taxonomy of *Sabethes* mosquitoes—the name has been applied to more than one species. This paper describes *Sa. gymnothorax*, a new species previously included under the concept and name of *Sa. tarsopus*, and redescribes *Sa. tarsopus* for comparison. These species were encountered repeatedly during long-term studies of ecological changes associated with the construction of the Bayano Hydroelectric Project in eastern Panama (Galindo 1973, Read 1977, Read et al. 1978, Adames et al. 1979, Read and Adames 1980, Galindo et al. 1983, Wali 1989).

The identity of *Sa. tarsopus* has always been confused. The reason for this confusion stems from the fact that Dyar and Knab (1908) described this species from a mixed series of *Sa. tarsopus* and *Sa. gymnothorax*, and later authors apparently could not distinguish between them. In fact, almost all of the previously determined museum specimens of *Sa. tarsopus* examined by one of us (REH) was a mixture of both species. Ironically, the origi-

nal description mentions the white scaling on the fore- and midlegs which is characteristic of *Sa. gymnothorax*, not *Sa. tarsopus* as defined by the lectotype specimen selected by Stone and Knight (1957). When Galindo et al. (1951) described the male of *Sa. tarsopus*, they unknowingly portrayed the genitalia of a species whose identity would not be fixed for six more years.

In 1959, Vargas and Díaz Nájera described the male genitalia of a species from southern Mexico which they misidentified as *Sa. belisarioi* Neiva, and contrasted it with a sympatric species which they identified as *Sa. tarsopus*. Two years later, these authors (Vargas and Díaz Nájera 1961) acknowledged that Lane and Causey (1955) had previously described the male of *Sa. belisarioi*, realized that their species was different, and named it *Sa. ortizi*. Unfortunately, Vargas and Díaz Nájera were also confused about the correct identity of *Sa. tarsopus*. Their concept of *Sa. tarsopus* actually applies to *Sa. gymnothorax*, and *Sa. ortizi* may be nothing more than a geographic variant of *Sa. tarsopus*. However, we are treating *Sa. ortizi* as a valid species for the time being based on relatively slight differences observed in the genitalia of the holotype male.

MATERIALS AND METHODS

The majority of specimens examined in this study are the individually reared F₁ progeny of wild-caught females collected in Panama. Individual females were captured from platforms built at various heights (up to 26 m) above ground along a wooden ladder ascending an emergent canopy tree, *Bombacopsis*

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quinata (Jacquin) Dugand. Mosquitoes were netted as they approached to blood feed. Some females were allowed to engorge to repletion and held individually in shell vials for three days prior to oviposition. Oviposition occurred in one-gallon paper ice cream cartons provided with a baby food jar half-filled with water. Larvae were reared individually on yeast infusion diet and occasionally provided with live larvae of other forest mosquitoes (*Haemagogus equinus* Theobald). Larval and pupal exuviae were collected and preserved in ethanol until mounted on microscope slides. Adults were pinned after 24 h from time of emergence. Other specimens, mainly adults, used in this study were either collected by one of us (JLP) or contained in the collection of the National Museum of Natural History (NMNH), Smithsonian Institution.

Laboratory observations of adult mosquitoes were made under lighting appropriately filtered to simulate natural light. The immature stages were studied using a differential interference contrast microscope. All measurements and counts are based on at least 10 specimens, except in the case of female genitalia. The morphological terminology recommended by Harbach and Knight (1980, 1982) is used throughout.

TAXONOMIC TREATMENT

Sabethes (Sabethes) gymnothorax, new species

Sabethes new species ("related" to *Sa. tarsopus*) of Galindo, de Rodaniche and Johnson 1959:558 (Panama; med. imp.).

Sabethes tarsopus of Dyar and Knab 1908:62–63 in part (description based on paralectotype females from Paraiso, Canal Zone, Panama and Cordoba, Mexico); Howard, Dyar and Knab 1915:24–26 (Mexico, Panama, excluding record from Bocas del Toro; A keys, ♀, bionomics note); Dyar 1919:119 (A key); Dyar 1923:168 (Panama); Bonne and Bonne-Wepster 1925:23, 35 (in part, C. Am.; A key); Dyar 1925:104, 105 (C. Am., Mexico, Panama; A key); Dyar 1928:9, 11–12 (Costa Rica,

Mexico, Panama; A key, ♀); da Costa Lima 1931:53, 62 (Costa Rica, Panama; A key); Martini 1935:63 (Mexico, record attributable to paralectotype); Galindo and Trapido 1955:546 in part? (Costa Rica; coll. rec.); Galindo and Trapido 1957:146 in part? (Nicaragua; coll. rec.); de Rodaniche and Galindo 1957:233 in part? (Guatemala; coll. rec.); Bertram 1971:745, 747 (Belize; coll. rec., A bionomics note); Palacios 1987:166 (Mexico; ♀, ♂ keys).

Sabethes (Sabethes) tarsopus of Dyar 1924:98, 99 (C. Am., Mexico, Panama; A key, ♀); Lane 1953:1058, 1061–1063 in part (Mexico, record apparently based on paralectotype from this country); Vargas and Díaz Nájera 1959:301–302 (Mexico; ♀*, coll. rec.); Vargas and Díaz Nájera 1961:75, 76 (Mexico; ♀, ♂); Díaz Nájera 1966:63 (Mexico; distr.); Díaz Nájera and Vargas 1973:123 (Mexico; distr.); Heinemann and Belkin 1977b:408, 415 (Belize; coll. rec., A bionomics); Heinemann and Belkin 1977c:486, 489 (Mexico; coll. rec., A bionomics); Clark-Gil and Darsie 1983:156, 180, 197, 266 in part? (Guatemala; A key, A bionomics note, coll. rec.); Hancock, Foster and Yee 1990:411, 413, 414 (Panama, colony material; A mating behav.).

Adult. A medium-sized mosquito with brilliant metallic-colored scaling; all scales of head capsule, thorax and abdomen very broad and flat; scales of vertex, occiput, pronotum, scutum, scutellum and abdominal terga metallic blue; scales of postgena, pleura, mesopostnotum, coxae and lateral margins of abdominal terga silvery white; abdominal sterna with metallic golden-brown scales; proboscis and legs metallic blue and violet, predominantly violet; legs with patches of snow white (non-metallic) scales.

FEMALE. *Head:* Eyes joined above and below. Scales behind interocular setae with distinct violet reflections when viewed from anterodorsal aspect; occiput with transverse fanlike row of short erect truncate scales at back of head. Ocular setae small, black, inconspicuous; 2 long, black, approximated interocular setae present; few small, pale post-

genal setae visible near margin of eye. Antenna 2.35–2.68 mm (mean 2.47 mm); pedicel large, black, surface pubescent, mesal surface with line of fine, inconspicuous black setae; flagellum black, flagellomeres of fairly even size and thickness, moderately verticillate as in male, whorls usually with 7 setae, longest setae about 0.3 antenna length, flagellomere 1 with inconspicuous cluster of dark scales on mesal surface. Clypeus and frons black, pubescent; clypeus only slightly larger than antennal pedicel. Proboscis slightly curved downward; length 2.55–2.80 mm (mean 2.67 mm), about 0.8 length of forefemur; entirely dark-scaled. Maxillary palpus short, about 0.2 length of proboscis; dark-scaled. *Thorax* (Figs. 1A,2A): Integument dark brown to black. Postpronota, scutum and scutellum with continuous covering of scales; scutum with setae restricted to anterior promontory (2–5, mode 3) and supraalar area (14–19, mode 15); scutellum with 2 long setae on midlobe, usually one on lateral lobe; mesopostnotum with large patch of broad, flat, silvery-white scales and cluster of 3–6 (mode 5) prominent black setae. Anteppronota well developed, closely approximated dorsally, dorsal surface flattened and covered with scales same as scutal scales, anterior margin parallel to back of head with row of 9–15 (mode 13) rather short, stout, black setae. Pro- and mesopleura almost completely covered with scales except anterior surfaces of proepisterna between anteprocoxal membranes (Fig. 2A) and anterior margin of mesokatepisternum along postprocoxal membrane; ante- and postprocoxal membranes and anterior half of metameron with scales; mesomeron, metapleuron and postmetacoxal membrane without scales; 1–4 (mode 2) dark prespiracular and 6–11 (mode 8) golden upper mesepimeral setae present, other setae absent, upper mesepimerals reach lateral area of mesopostnotum. *Wing*: Length 4.5–5.0 mm (mean 4.7 mm); entirely dark-scaled with blue, green and yellow reflections when viewed from certain angles; alula with few fine setae on margin distally; scales on radial and medial veins broad and generally asymmetrical; calypters without setae. *Halter*: Sca-

bellum without scales, integument pale; pedicel and capitellum dark-scaled. *Legs* (Fig. 1C): Coxae heavily scaled, each with a prominent distal seta on outer margin which projects over trochanter. Trochanters mainly white-scaled, with some dark scales on dorsal surface. Femora, tibiae and tarsi mainly dark-scaled, with the following slightly variable characteristics: foreleg with white scaling ventrally at base of femur and on ventral surface of tarsomeres 3 and 4, tibia with paddle formed of outstanding scales on distal half and tarsomere 1 with few to many semierect scales sometimes forming a small basal paddle, forefemur length 3.1–3.5 mm (mean 3.3 mm), about 1.2 length of proboscis; midleg with a large paddle of outstanding scales occupying distal half of tibia and all of tarsomeres 1 and 2, tarsomere 2 white-scaled with paddle fringe on dorsal side only, femur with narrow line of white scaling on proximal half of ventral surface (usually not visible in anterior view), tibia with a large patch of white scales on ventral side before paddle, tarsomere 3 and all but distal part of 4 white-scaled, tarsomere 4 without fringe of semierect scales (small paddle) on posterodorsal margin; hindleg without paddle, femur narrowly white-scaled on most or all of ventral surface and bearing a small spot of white scales anteriorly at apex, tarsomeres 4 and 5 white-scaled ventrally. Ungues small, simple, black. *Abdomen*: Line of demarcation between dorsal dark and lateral pale scaling of terga more or less straight; lateral pale areas with long scales at edges of terga which project downward and largely or completely conceal sterna in lateral view of compressed specimens. *Genitalia* (Fig. 3A-E): Tergum VIII (not figured) with rounded lateral margins, anterior margin slightly convex, posterior margin very slightly concave, all but narrow anterior area covered with scales, posterior margin lined with setae, longest setae in most posterior row, these setae generally about as long as tergum, those on posterolateral corners longer. Sternum VIII biconcave, broadest basally, covered with setae and scales as illustrated. Tergum IX, vaginal lips, insula, postgenital lobe, cerci and membranous areas densely aculeate; tergum

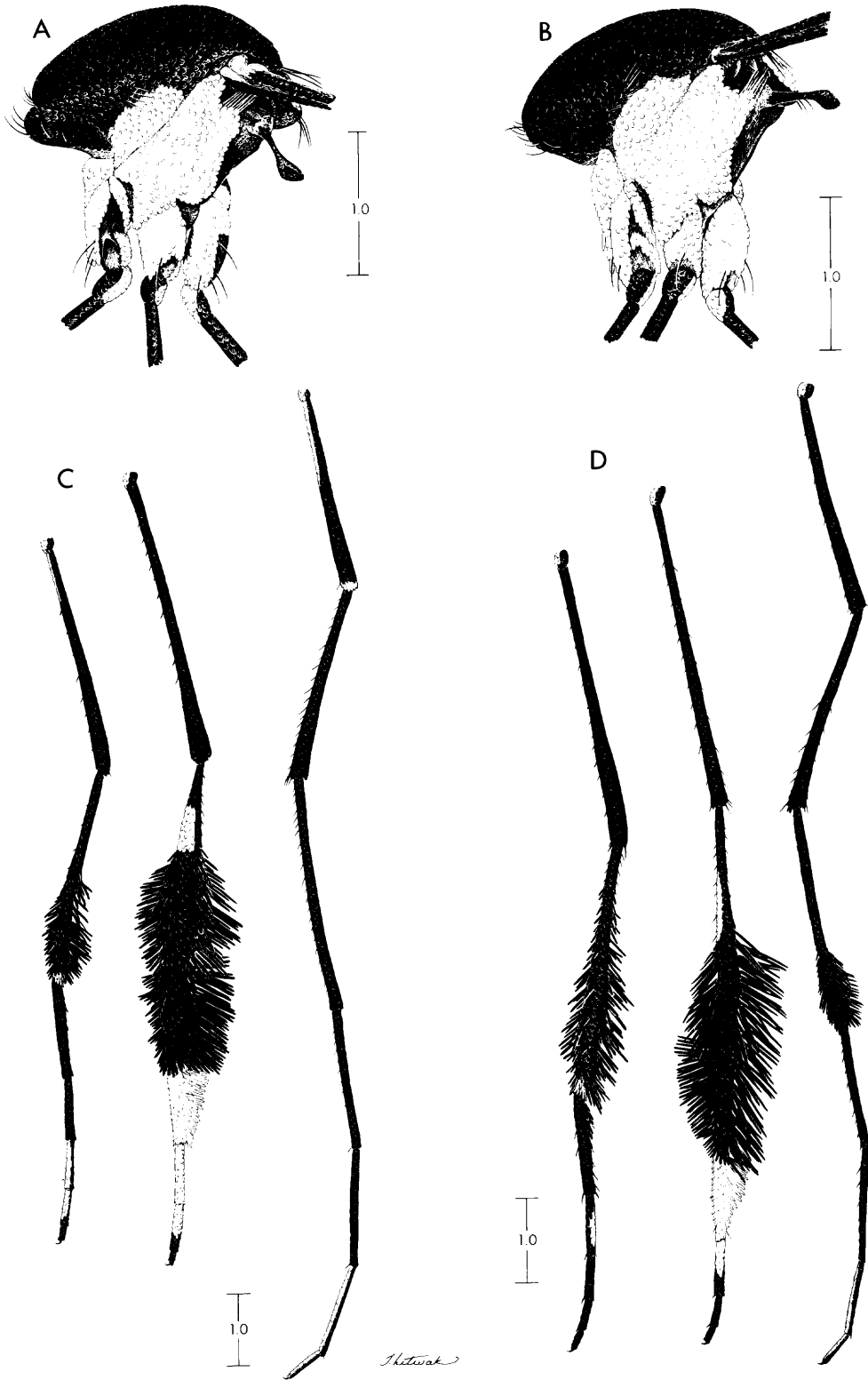


Fig. 1. Thorax (left side) and left legs (anterior aspects) of *Sabethes gymnothorax* (A,C) and *Sabethes tarsopus* (B,D). Scales in mm.

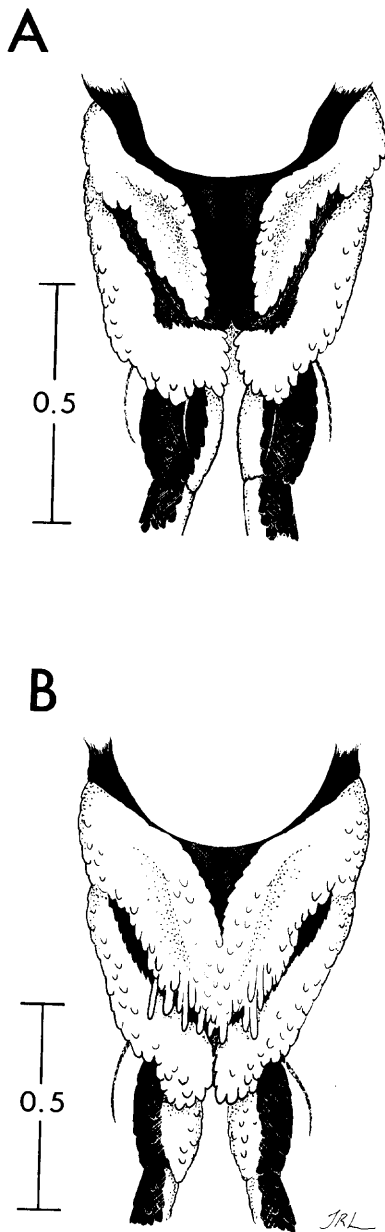


Fig. 2. Anterior aspect of proepisterna (below head, not shown) showing distribution of scales in *Sabethes gymnothorax* (A) and *Sabethes tarsopus* (B). The specific name *gymnothorax* refers to the relative absence of scales from this area of the thorax. Scales in mm.

IX narrow, with 2 or 3 setae on either side; insula slightly longer than wide, evenly rounded distally, with slight depression in middle and 5–7 small setae on either side; postgenital lobe about twice length of cerci,

broad basally and rather abruptly narrowed in distal 0.3–0.4, distal third or so divided by median cleft, ventral surface largely covered with short setae, with basomedian patch of minute setae adjacent to upper vaginal lip, dorsal surface with line of 4 or 5 longer setae extending from near midlength to apex on either side of median cleft.

MALE. Slightly smaller but otherwise extremely similar to female, bearing the following primary differences. *Head:* Proboscis narrowly pale-scaled ventrally from near base to labellae, these scales appearing yellowish in lateral view, white in ventral view. Pedicel of antenna largely or partly (ventrally) pale (yellowish orange). Maxillary palpus slightly smaller, about 0.13 length of proboscis. *Genitalia* (Fig. 4A–E): Tergum VIII (ventral in position) (not figured) narrow, about 3 times as wide as long, posterior edge concave in middle, posterior margin lined with setae which become longer and more numerous posterolaterally. Tergum and sternum IX fused laterally, forming a complete ring of sclerotization; tergum IX lobe with a compact single or partially double row of 6–9(7) relatively short, thick setae with apices slightly bent laterad; interlobular bridge broad, width about 0.7 length between lobes, posterior margin slightly convex. Gonocoxite elongate, broadest in middle, length about 2.0 of greatest width, distal half of lateral and sternal surfaces covered with short setae and scattered scales, apex on mesal side of gonostylus with cluster of distinctly longer setae and scales, tergal surface with 2 long tergomal setae (homologous with tergal triad of Belkin et al. 1970); basal mesal lobe irregular in outline, inner caudal angle strongly produced, with scattered short setae and 2 longer setae on outer caudal margin. Gonostylus as long as gonocoxite; stem rather long, narrow, about 0.55 of total length, slightly sinuous; head as figured, 4 lobes developed (homologies not definitely established with lobes in species of *Wyeomyia* and other *Sabethes*), lobe E apparently not developed; lobe A a prominent digiform process arising from proximal portion of tergal surface, bearing a rather long,

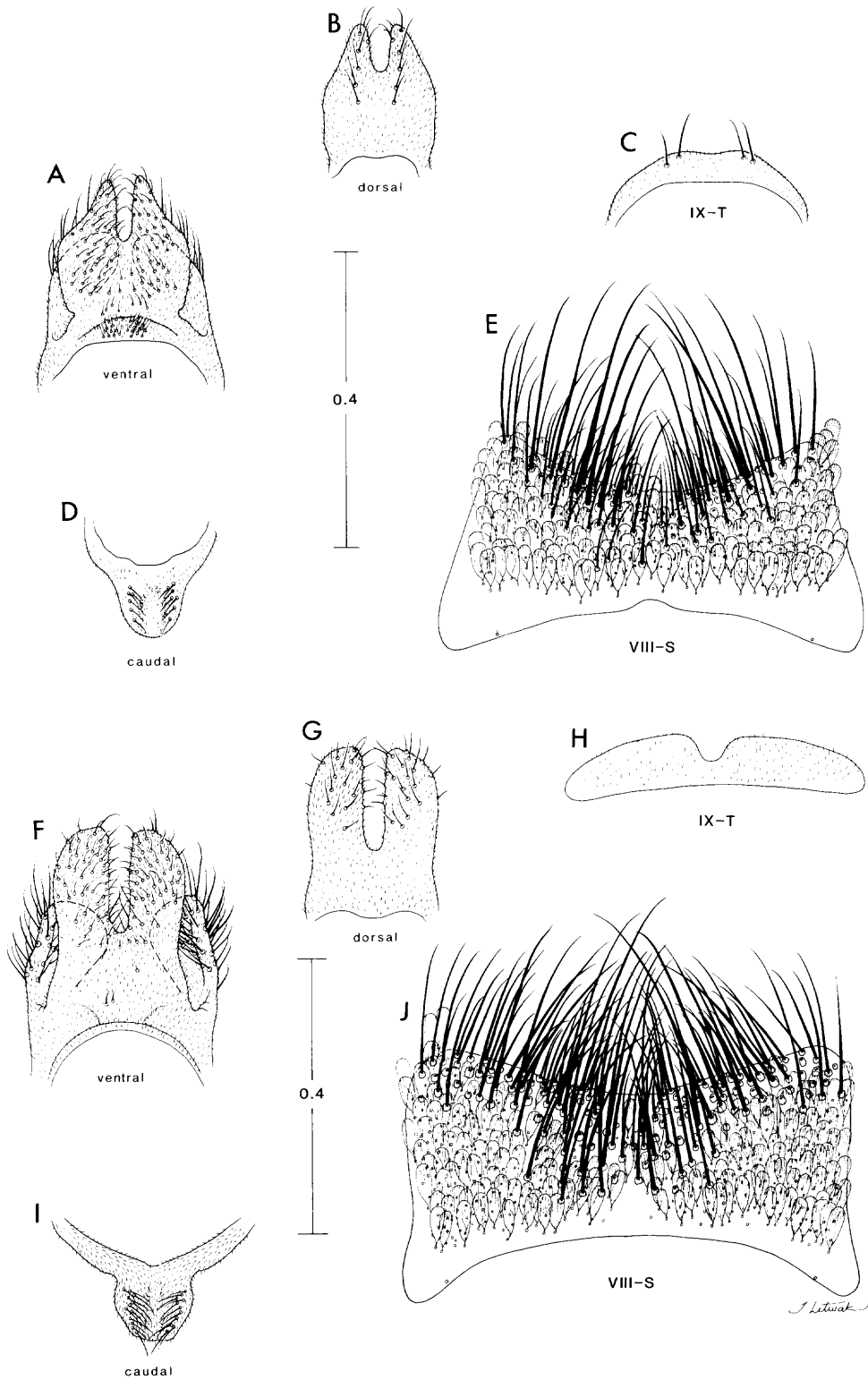


Fig. 3. Female genitalic structures of *Sabethes gymnothorax* (A-E) and *Sabethes tarsopus* (F-J). Aspects as indicated (A,F, postgenital lobe and cerci; B,G, postgenital lobe; C,H, tergum IX; D,I, insula; E,J, sternum VIII). Scales in mm.

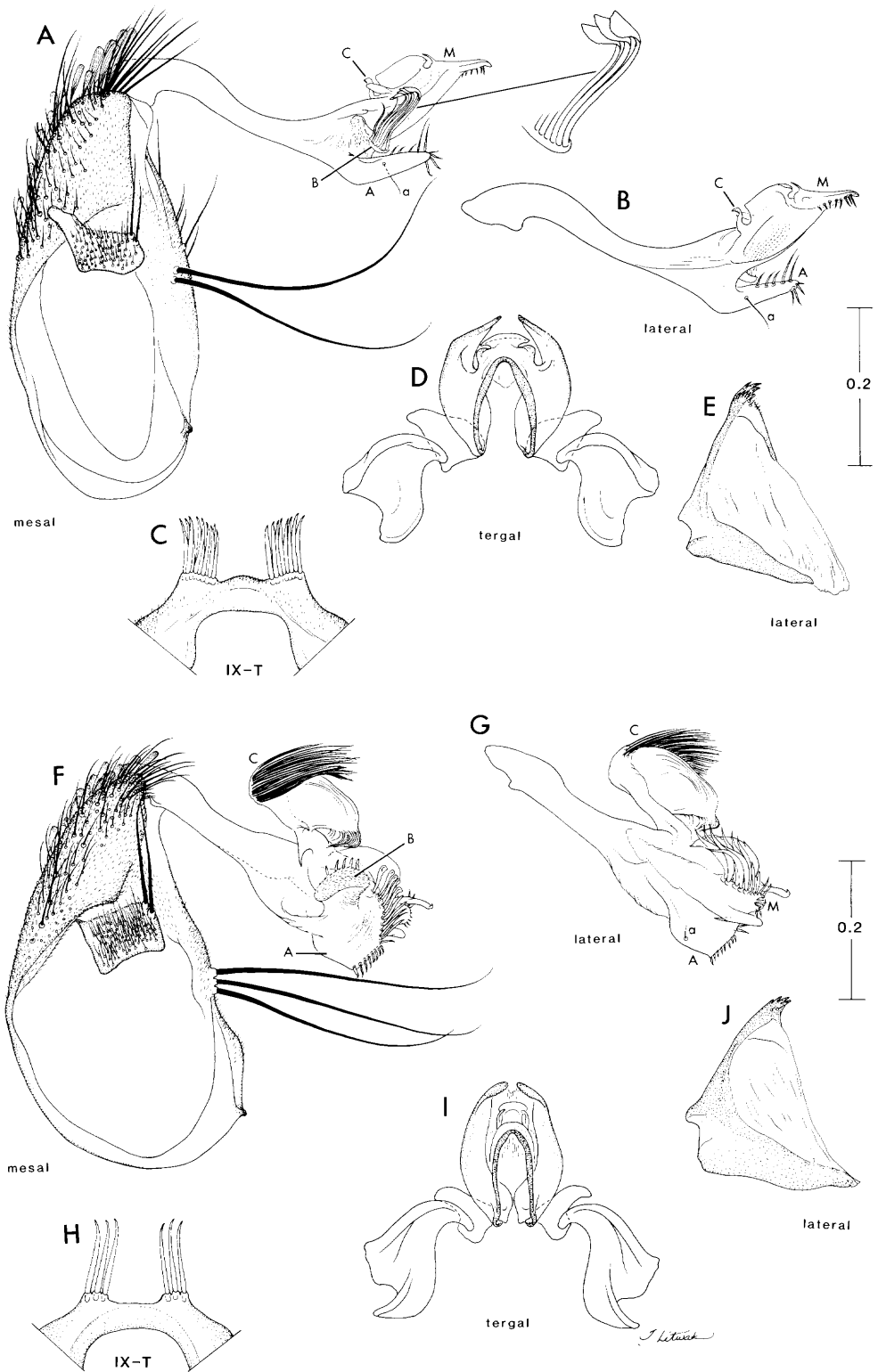


Fig. 4. Male genitalic structures of *Sabethes gymnothorax* (A-E) and *Sabethes tarsopus* (F-J). Aspects as indicated (A,F, gonocoxopodite and basal mesal lobe; B,G, gonostylus; C,H, tergum IX; D,I, aedeagus, with parameres and basal pieces attached; E,J, proctiger). Scales in mm.

slender seta **a** on middle of outer (lateral) surface and several stout short setae at apex and in a row on sternal margin; lobe **B** a rather narrow, flattened projection borne on inner (mesal) surface near base of lobe **A**, distal margin with appressed row of long flexible, apically flattened setae which project sternodistad in plane more or less parallel to lateral surface of lobe **M**; lobe **C** a small sinuous projection borne sternolaterally at base of lobe **M**, bearing minute spicules or serrations on recurved side of tip; lobe **M** laterally compressed and larger than the other lobes, apical attenuate portion (possibly homologous with lobe **M'** of Belkin et al. 1970) with row of short setae on tergo-lateral margin, sternal margin with a small retrorse spinelike process at base of apical attenuate portion and a keel-like ridge between this process and base of lobe **C**. Aedeagus nearly circular in outline in tergal view; submedian tergal arms joined beyond middle; apical tergal arms not joined, rather widely separated. Proctiger (in lateral view) with rather narrow basal sclerotization (tergum **X**); paraproct with 1,2(2) minute cercal setae at apex.

Larva (Fig. 5). Character and positions of setae as figured; numbers of branches in Table 1. **Head**: Wider than long; length 0.83–0.99 mm (mean 0.91 mm); width 1.15–1.41 mm (mean 1.31 mm); moderately and evenly tanned. Maxilla (Fig. 6) elongate, narrowed distally with apex produced into a long, tapered, mesally curved tooth; mesal teeth (= laciniarastrium 1) flattened with decurved tips, in slightly arched row with longest tooth about 0.25 length of apical tooth. Mandible as figured (Fig. 6). Dorsomentum with 6–8 (mode 7) teeth on either side of median tooth, median tooth and most lateral tooth of either side larger than the other teeth. Anterior edge of labiogula with minute tubercles; hypostomal suture complete, curved, continued caudad of posterior tentorial pit; occipital foramen a large V-shaped opening with arms of V extending dorsolaterally to span entire posterior width of head, margin heavily tanned, ventrocaudal margin with collarlike edge. Seta 4-C usually lateral to 1-C; 5–7-C evenly spaced on more or less straight transverse line;

13-C in line with 11,12-C; 14,15-C slightly stronger than other cranial setae, 14-C about same length as antenna, single; 15-C not much shorter than 14-C, usually double. **Antenna**: Short, slender, slightly broader basally; apex with 2 small triangular spinelike projections on inner side; length 0.28–0.32 mm (mean 0.29 mm). Seta 1-A normally single, borne dorsally about 0.75 from base. **Thorax**: Integument hyaline, smooth. Plate bearing seta 4-P with rather prominent caudolateral spinelike process; plates bearing setae 5–7-P and 9–12-P narrowly connected posterior to insertions of setae, plate with 2 small spinelike processes caudad of seta 7-P; setae 6,7,9,10-P well developed, with numerous branches. Seta 11-P,M,T stout, spinelike, single or split. Seta 1-M single or double, usually single; 8-M absent; 13-M large, developed like 8-P. Seta 8-T dorsal to 9-T, borne laterally between plates bearing 7-T and 9–12-T; 13-T about 0.5 length of thorax, borne on small basal plate. **Abdomen**: Integument hyaline, smooth. Seta 1-I,II mesad of and not much larger than seta 2; 1-III-VII laterad of and significantly larger than seta 2; 1-VII unmodified; 3-I,II long, single; 6,7-I,II well developed, seta 7 with more branches than seta 6; 7-III unusually large, with 2–4 branches; 10-I well laterad of seta 13; 13-I-V borne on basal plate, 13-I,II variable in size and development, usually multibranched and stellate, 13-III-V rather stout and single; seta 5-II-VI on basal plate, single or double, usually single on more posterior segments; 9-II,III anterior to seta 7; 9-IV-VI anterior to seta 6; 4-III,IV developed differently than 4-I,II,V, normally single, occasionally double on III, 4-IV-VI and 3-V borne on margin of plate supporting seta 5; 4,5-VII borne on margin of plate supporting seta 3; 5-VII single and slightly dorsad of seta 4; 10-VII relatively long, with 2–6(6) branches; 12-IV laterad of seta 13; 12-V in line with or slightly mesad of seta 13. **Segment VIII**: Comb with 5–11 (mode 6) small, scattered scales, individual scales of irregular form with one or 2 large apical and a variable number of smaller lateral spicules. Setae 2,4,5-VIII about length of seta 1; 5-VIII close to setae 3 and 4 and almost directly anterior

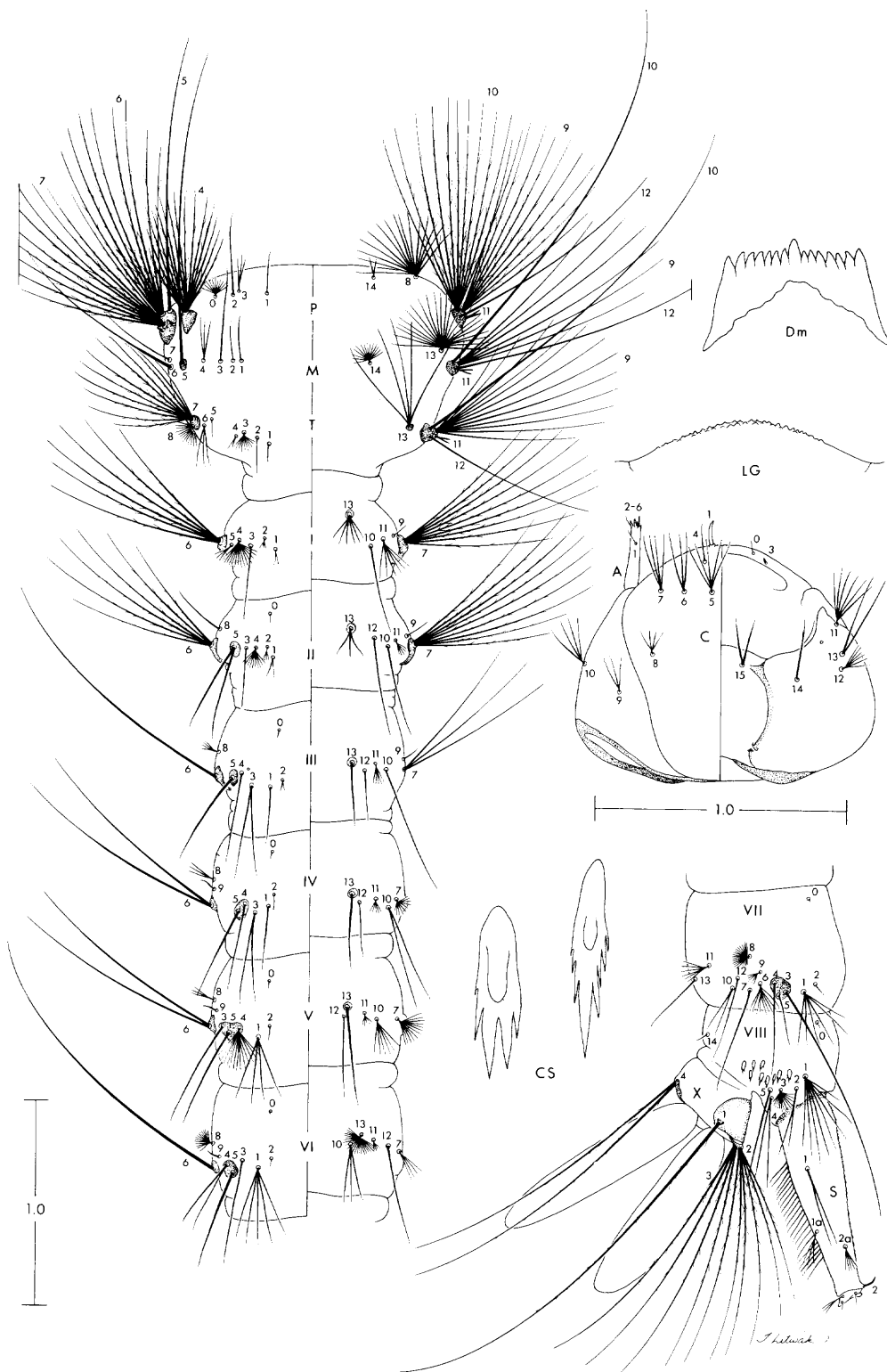


Fig. 5. *Sabethes gymnothorax*, fourth-instar larva. Scales in mm.

Table 1. Numbers of branches for fourth-instar larval setae of *Sabethes gymnothorax*.

Seta no.	Head C	Thorax			Abdominal segments		
		P	M	T	I	II	III
0	1	9-14(14)	—	—	—	1	1
1	1	1,2(1)	1,2(1)	1	1-4(2)	1-3(1)	1
2	—	1	1	1,2(1)	1-4(3)	1-4(2)	1,2(1)
3	1	1-3(2)	1	2-10(7)	1	1	1,2(1)
4	1	11-17(13)	2-6(3)	2-5(4)	10-19(11)	8-13(9)	1,2(1)
5	4-7(5)	1	1	1,2(2)	3-5(3)	1,2(2)	1,2(2)
6	2-5(3)	8-11(9)	1	1-4(3)	5-7(6)	5-7(6)	1
7	3-5(4)	9-12(12)	1,2(1)	7-12(11)	9-13(10)	8-13(11)	2-4(3)
8	3-6(4)	13-29(20)	—	8-19(15)	—	1	3-5(4)
9	3,4(3)	7-11(11)	6-8(7)	12-18(15)	1	1	1
10	2-4(3)	10-14(12)	1	1	1	1	1
11	3-11(7)	2-5(2)	1,2(1)	1-5(2)	2-6(4)	1-5(3)	3-5(3)
12	4-6 (4)	1	1	1	—	1-3(1)	1
13	2	—	11-26(24)	5-9(9)	3-11(6)	1-7(4)	1
14	1	1-4(3)	13-27(20)	—	—	—	—
15	1,2(2)	—	—	—	—	—	—

Seta no.	Abdominal segments					
	IV	V	VI	VII	VIII	X
0	1	1	1	1	1	—
1	1	2-6(4)	4-8(5)	5-7(6)	6-10(8)	1
2	1,2(1)	1,2(1)	1	1	1,2(2)	5-9(6)
3	1,2(1)	1	1,2(1)	1	10-18(12)	4-6(5)
4	1	7-16(11)	2-4(2)	1	1,2(2)	2,3(2)
5	1,2(1)	1	1	1	1	—
6	2	2	1	8-16(13)	—	—
7	8-14(10)	9-16(14)	2-6(4)	1,2(1)	—	—
8	3,4(3)	3-7(4)	13-21(17)	18-24(20)	1-S	1,2(1)
9	1	1	1	3-5(3)	1a-S	2-4(3)
10	1,2(1)	4-8(8)	2-5(3)	2-6(6)	2a-S	3-5(4)
11	3-7(3)	3-7(5)	3-7(5)	5-9(5)	—	—
12	1	1	1	1,2(1)	—	—
13	1	1	19-25(23)	1,2(1)	—	—
14	—	—	—	—	1	—
15	—	—	—	—	—	—

to 4. *Siphon*: Short, stout, tapered, diameter at apex about half that at base, length 0.88–1.06 mm (mean 0.98 mm), width at base 0.29–0.38 mm (mean 0.33 mm), index 2.60–3.33 (mean 3.02); surface with inconspicuous rows of minute spicules, moderately tanned, basal margin dark. Pecten with 22–60 (mean 42) filaments, extending from below level of seta 1-S to about level of seta 2a-S, a few filaments double. Seta 1-S inserted about 0.3 from base; 1a,2a-S each represented by one seta, 2a-S distal to 1a-S. *Segment X*: Saddle small, length 0.22–0.24 mm, not extending to lateral midline; siphon/saddle index 3.7–3.6

(mean 4.3). Seta 1-X about 2.0 length of siphon; 4-X borne on opposite sides of a transverse ventrocaudal sclerite, nearly length of seta 1; 4b-X absent. Anal papillae large, sausage-shaped, length of siphon or longer.

Pupa (Fig. 6). Character and positions of setae as figured; numbers of branches in Table 2. *Cephalothorax*: Lightly tanned. Seta 5-CT very long, about 5.0 length of 4-CT; 8,9-CT nearly same length, 8-CT usually single (1,2), 9-CT single to triple, more often single; 10–12-CT single, 12-CT rarely double, 10-CT less than half length of 11,12-CT. *Trumpet*: Moderately tanned; length 0.42–0.52 mm (mean

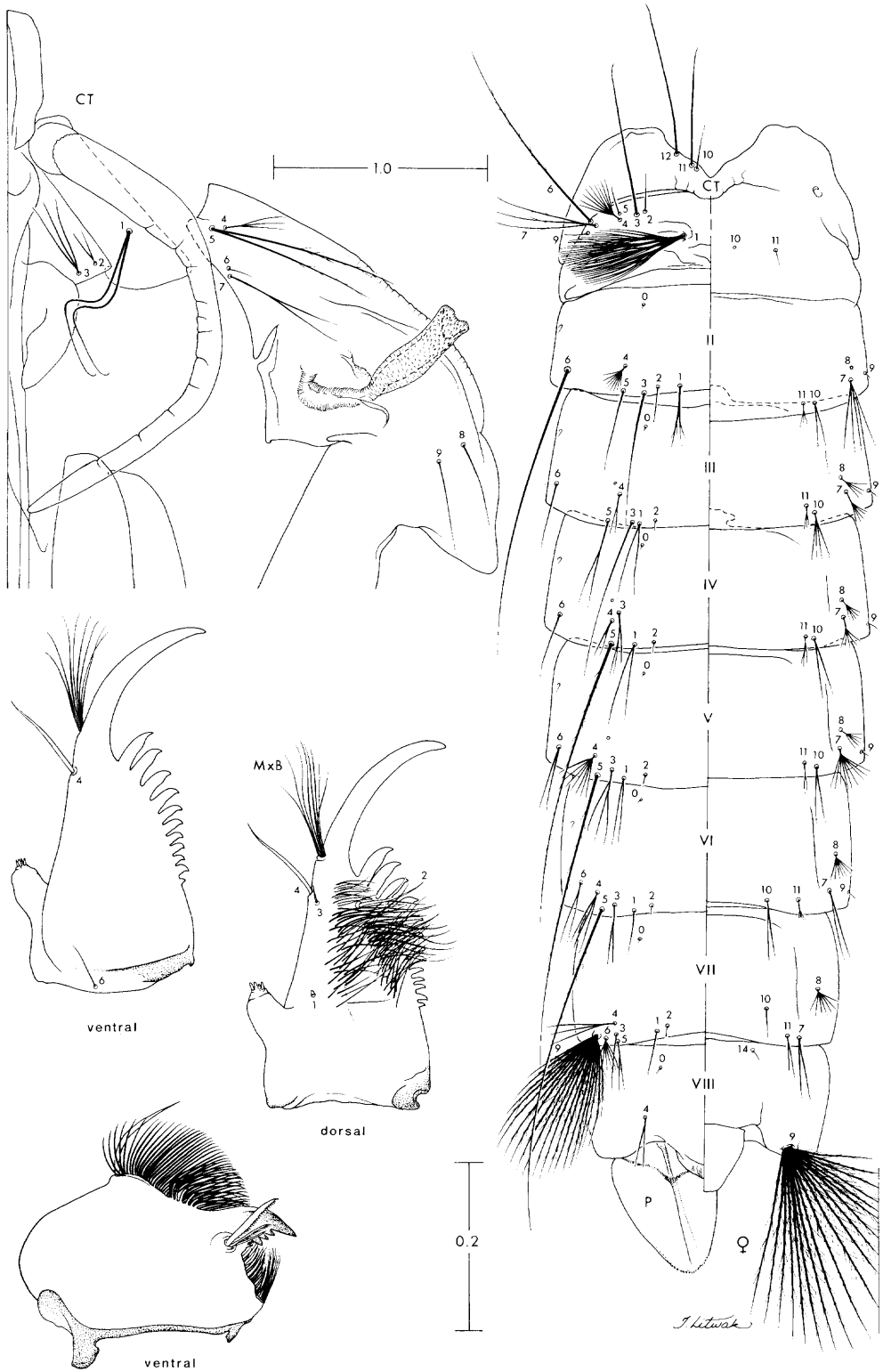


Fig. 6. *Sabethes gymnothorax*, pupa and mouthparts of fourth-instar larva. Scales in mm.

Table 2. Numbers of branches for pupal setae of *Sabethes gymnothorax*.

Seta no.	Cephalothorax CT	Abdominal segments			
		I	II	III	IV
0	—	—	1	1	1
1	2	48-78	1-5(3)	1-3(2)	1-3(2)
2	1-4(2)	1	1	1	1
3	2-4(3)	1	1	1	1-9(3,6)
4	1-3(2)	8-15(9)	4-7(6)	2-4(3)	2-4(3)
5	2,3(2)	1,2(1)	1-3(1)	2-5(3)	1
6	1	1	1	1-3(1)	1-3(2)
7	2,3(3)	3-5(4)	3-5(5)	2-8(5)	1-5(2)
8	1,2(1)	—	—	3-10(5)	5-10(8)
9	1-3(1)	1-4(2)	1	1	1
10	1	—	1-4(2)	1-3(2)	1-4(2)
11	1	1,2(1)	2-5(2)	2-4(3)	1-4(3)
12	1,2(1)	—	—	—	—
13	—	—	—	—	—
14	—	—	—	—	—

Seta no.	Abdominal segments					Paddle P
	V	VI	VII	VIII	IX	
0	1	1	1	1	—	—
1	1-5(2)	1-3(2)	1-3(1)	—	—	—
2	1	1	1	—	—	—
3	1-5(4)	2-4(2)	1-4(2)	—	—	—
4	4-10(9)	1-3(2)	1-3(2)	1-4(2)	—	—
5	1	1	1-3(2)	—	—	—
6	2,3(3)	2-4(2)	3-8(7)	—	—	—
7	7-14(11)	1-3(2)	1,2(2)	—	—	—
8	4-9(7)	6-11(9)	4-13(7)	—	—	—
9	1	1	17-22(19)	20-25(22)	—	—
10	1-3(3)	1-3(2)	1	—	—	—
11	1-5(2)	2-7(3)	1,2(2)	—	—	—
12	—	—	—	—	—	—
13	—	—	—	—	—	—
14	—	—	—	1	—	—

0.47 mm); pinna 0.09-0.16 mm (mean 0.12 mm), about 0.25 trumpet length; width at midlength 0.12-0.17 mm (mean 0.14 mm); index 2.8-4.1 (mean 3.3). *Abdomen*: Lightly to moderately tanned, sterna darker anteriorly; length 4.2-5.0 mm (mean 4.7 mm). Seta 6-I very long, about 2.0 length of 7-I; 1-II rather strong, split distally, 1-II mesad of seta 3; 6-II very long, about 2.5 length of tergum III; alveolus of 8-II usually present; 5-III much smaller than 5-IV-VI, about 0.7 length of following tergum; 5-IV-VI more than 2.0 length of following tergum; 3-IV developed like 3-V, VI; 6-III, IV single to triple, 6-V, VI at least double; 1-VII present; 8-VI, VII normal, ventral. *Genital lobe*: Lightly to mod-

erately tanned; length about 0.35 mm in female, about 0.63 mm in male. *Paddle*: Lightly tanned; short, only slightly longer than segment VIII, narrowed more or less evenly from near base, rounded apically, margins smooth except for minute thornlike spicules at apex, outer part only slightly larger than inner part, dorsal surface with differentiated membranous area at base, integument darkly tanned along edge of membranous area; length 0.68-0.77 mm (mean 0.72 mm); width at widest point 0.40-0.49 mm (mean 0.44 mm); index 1.51-1.71 (mean 1.63).

Taxonomy. *Sabethes gymnothorax* belongs to a group of species which includes *Sa. amazonicus* Gordon and Evans and *Sa. forattinii*

Cerqueira, recognized here as the Amazonicus Group. *Sabethes amazonicus* is recorded from several countries in South America while *Sa. forattinii* is known only from Brazil. The adults of these species differ conspicuously from *Sa. gymnothorax* in lacking mesopostnotal scales and a white spot on the midtibia, and males of these bear a small paddle-like fringe of scales on midtarsomere 4 which is absent in males of *Sa. gymnothorax*. The larval and pupal stages of *Sa. amazonicus* are unknown, and those of *Sa. forattinii* are known only from the exuviae of an individually reared male (Forattini and Toda 1967). Based on the incomplete description of the larval exuviae, it appears that *Sa. forattinii* differs from *Sa. gymnothorax* in the positional relationships of setae 4,5,6,7-C and the distance between setae 14- and 15-C. The pupa of *Sa. forattinii* illustrated by Forattini and Toda differs from that of *Sa. gymnothorax* in the character of setae 4,7-V. These setae, shown as single in *Sa. forattinii*, have multiple branches in *Sa. gymnothorax*.

Bionomics. The type locality of *Sa. gymnothorax* is Majé Island (9° 07' N 78° 51' W), located in the Bayano Reservoir, Panama Province, Republic of Panama. The area of Majé at mean water level is approximately 1,433 hectares. Topography is hilly, elevations varying from zero to about 70 m above lake level. Maximum lake level is 62 m above sea level. The dominant soil type is derived from porous limestone that drains water quickly. Rapid drainage combined with the pronounced four-month dry season (January to April) strongly influences the vegetation type. Although Majé is classified as TROPICAL MOIST FOREST (TRANSITION) according to the Holdridge system (Holdridge and Budowski 1956), dominant plants consist of drought-resistant species such as Cuipo, *Cavanillesia plataniifolia* (Humboldt and Bonpland) Humboldt Bonpland Kunth, and Sabal palm, *Sabal allenii* L.H. Bailey. The rainy season (May to December) is sufficiently wet to support epiphytic growth of orchids, bromeliads, arboreal cacti and lianas (woody vines). Average annual rainfall at Majé in 1986-87 was 1,626 mm.

Sabethes gymnothorax is a diurnal, canopy-dwelling mosquito. Blood-seeking *Sa. gymnothorax* approached slowly, tending to alight on the nose or around the head. Females oviposited while hovering over a water-filled container. Larvae were predaceous and attacked and consumed *Haemagogus* larvae in the laboratory. Larval development took 4-5 weeks at 25°C under laboratory conditions.

Distribution. Specimens of *Sa. gymnothorax* examined during this study were collected in Belize, Costa Rica, Honduras, Mexico, and Panama. The species undoubtedly occurs throughout Central America and probably extends into northwestern areas of South America. A few imperfect adult females from Venezuela in the NMNH collection appear to be *Sa. gymnothorax*, but this needs to be confirmed through study of additional material.

Etymology. The specific name is derived from the masculine Greek words *gymnos* (bare, naked) and *thorax* (breastplate, chest) in reference to the character of the proepisterna which readily distinguishes this species from *Sa. tarsopus* (see Fig. 2).

Material examined. 124 specimens (41♂, 11♂, 4♀ genitalia, 6♂ genitalia, 29 larval exuviae, 29 pupal exuviae, 4 fourth-instar larvae), including 29 individual rearings (28 larval and 1 pupal). BELIZE. Cayo: Mountain Pine Ridge, 1961 Road, 620 m, 18 Sep 90, WRBU/USUHS, ACC 1446, 1♀ (BHZ 143) (landed on nose of human); San Antonio, mile 9 on Chiquibul Rd, 300 m, 4 Jul 67, D.S. Bertram, 1♀ (BH A259) (biting-landing on man on tower in forest, 8 m above ground, 1550 h). COSTA RICA. Higuito, San Mateo, Pablo Schild, 2♀. HONDURAS. Yoro: Camp Big Bear, approx. 800 m, 7 Mar 86, R. Johnson, ACC 1221, 1♀ (HONC 320). MEXICO. Oaxaca: above Valle Nacional, 13 May 63, 1♀; Vera Cruz: Cordoba, 16 Mar 08, 1♀, 1♀ genitalia (paralectotype of *Sa. tarsopus*, type no. 11972); about 2.5 km E of Cordoba, 900 m, 13 Jul 64, DF, DV, 2♀ (MEX 26) (landing and flying in coffee plantation, 1000 h, partial shade); same location and collectors, 14 Jul 64, 1♀ (MEX 32) (flying in coffee plantation, 1000 h, partial shade); same location and

collectors, 16 Jul 64, 3♀ (MEX 37) (biting and landing in coffee plantation, 1300 h, full-partial sun); same location, 2 Aug 64, EF, 1♀ (MEX 92) (landing in coffee plantation, 1000 h). PANAMA. *Darien*: Pucro, Rio Tacarcuna Valley, 600 m, 12 Jul 63, AQ, 1♀, 1♀ genitalia (PA 457) (attracted to man in forest, 8 m above ground, 1000–1400 h). *Canal Zone*: Gamboa, Pipeline Rd, Jul 67, W.W. Wirth, Malaise trap, 1♀; Gatun, April 21/20, C.H. Bath, 1♀ (Z-1213), September 1934, J.B. Shropshire, 1♀; Paraiso, I.11.07, A.H. Jennings, 1♀ (paralectotype of *Sa. tarsopus*, type no. 11972). *Panama*: Bayano Reservoir, Majé Island (9° 07' N 78° 51' W), ACC 1402, 10-IV-1989, 1LePe♂ (134838), 30-VI-1989, 2LePe♀ (197916, 107925), 13-VII-1989, 1LePe♀ (134644), 16-VII-1989, 2LePe♀, 1♀ genitalia (134645, 134646); ACC 1411, 26-VI-1989, 1L mouthparts (107918), 1-VIII-1989, 2L (107955-02, -04), 9-VIII-1989, 1L (107955-03), 11-VIII-1989, 1L (107955-05); ACC 1518, 11.IV.85, 1Pe♀ (PT-ST-03-26), 6LePe♀ (PT-ST-03-16, -23, -27, -28, -31, -32), 2LePe♂ (PT-ST-03-25, -30), 3LePe♂, 3♂ genitalia (PT-ST-03-24, -29, -33); 20.IV.85, 1LePe♂, 1♂ genitalia (PT-ST-03-19); 22.IV.85, 2LePe♀ (PT-ST-03-20, -22); 29.IV.85, 2LePe♀ (PT-ST-03-13, -14), 1LePe♂ (PT-ST-03-15); 9.V.85, 2LePe♂, 2♂ genitalia (PT-ST-03-17, -18); 10.V.85, 1LePe♀ (PT-ST-03-21); 28.V.85, 1Le (PT-ST-03-12), 1LePe♀ (PT-ST-03-11), 1LePe♂ (PT-ST-03-10). Cerro Campana (about 4 km N of Chica), 700 m, 29 Aug 63, AQ, 2♀ (PA 540) (attracted to man in forest, 18 m above ground, 1000–1400 h). Pacora, 1 Aug 50, 1♀; 18 Nov 52, 1♀.

The type series of *Sa. gymnothorax* consists of all of the specimens from Majé Island listed above: holotype male (PT-ST-03-33) with associated larval and pupal exuviae and dissected genitalia on 2 separate slides; 18 paratype females (1 with Pe, 15 with LePe, and 2 with LePe and dissected genitalia), 11 paratype males (5 with LePe; 6 with LePe and dissected genitalia), 1 paratype larval exuviae, 4 paratype fourth-instar larvae, and mouthparts of 1 non-extant paratype larva. These specimens are the F₁ progeny of wild-caught females collected and processed as indicated

in the materials and methods. Two paratypes (PT-ST-03-10, -31) are deposited in the Natural History Museum, London. The holotype and the other paratypes and specimens examined in this study are located in the NMNH.

Sabethes (Sabethes) tarsopus Dyar and Knab

tarsopus Dyar and Knab, 1908:62. Lectotype female: Bocas del Toro, Panama (NMNH), designated by Stone and Knight 1957:118.

The following literature summary pertains to records and information concerning *Sa. tarsopus* in Central America only. The presence and distribution of this species in countries of South America require confirmation.

Sabethes tarsopus of Howard, Dyar and Knab 1915:25–26 (in part, record from Bocas del Toro, Panama only); Galindo and Trapido 1955:546 in part? (Costa Rica; coll. rec.); Galindo, Carpenter and Trapido 1955:160, 163 (Panama; A bionomics); Galindo and Trapido 1957:146 in part? (Nicaragua; coll. rec.); de Rodaniche and Galindo 1957:233 in part? (Guatemala; coll. rec.); Galindo, de Rodaniche and Johnson 1959:558 (Panama; med. imp.).

Sabethes (Sabethes) tarsopus of Galindo, Carpenter and Trapido 1951:91–92 (Panama; ♂*); Lane 1953:1058, 1061–1063 in part (Costa Rica, Panama; ♂*, key); Belkin, Schick and Heinemann 1965:49, 57 (Panama; info. on type, A, L, E bionomics note); Forattini 1965:153–155, 193 in part (biol., ♂); Cova Garcia, Sutil and Rausseo 1966:79 (♂* key); Heinemann and Belkin 1977a:247, 285 (Costa Rica; coll. rec., A bionomics); Heinemann and Belkin 1978:131, 133, 145 (Panama; coll. rec. [coll. nos. 444 and 457 on p. 141 and no. 540 on p. 145 not confirmed], A bionomics); Clark-Gil and Darsie 1983:156, 180, 197, 266 in part? (Guatemala; A key, A bionomics note, coll. rec.).

This species bears only a superficial resem-

blance to *Sa. gymnothorax*. It differs as follows.

Adult. A slightly larger and darker mosquito; dark scaling of head, thorax and abdomen reflecting more gold than blue, appearing somewhat greenish in light of certain angles; dark scaling of proboscis and legs metallic blue-black with slight violet sheen.

FEMALE. *Head:* Scales behind interocular setae without distinct violet reflections; dark scaling more extensive, extending over ventrolateral portion of postgena. Ocular setae longer, more distinct; postgenal setae longer, more numerous, rather conspicuous. Antenna shorter, 2.05–2.20 mm (mean 2.12 mm); mesal surface of pedicel with inconspicuous patch of black scales; proximal flagellomeres noticeably thicker, decreasing in thickness and reaching normal size near mid-length of flagellum, rather weakly verticillate, flagellar whorls usually with 4 short setae, longest setae about 0.15 antennal length. Proboscis shorter, length 2.25–2.48 mm (mean 2.33 mm), about 0.65 length of forefemur. Maxillary palpus about 0.2 length of proboscis. *Thorax* (Figs. 1B, 2B): Line of demarcation between scaling of ante- and postpronota indistinct; antepronotum with line of 9–14 (mode 12) short black setae. Anterior promontory setae normally absent, 1 seta may be present; supraalar area with 15–22 (mode 18) setae; scutellum with 2 long setae on midlobe and 2, sometimes 3, on lateral lobe; mesopostnotum with scales and setae as in *Sa. gymnothorax*, 4–11 (mode 6) setae present. Anterior surface of proepisterna almost completely covered with scales, these very long ventrally (Fig. 2B); scales also cover dorsal part of mesomeron (these probably inserted on mesokatepimeron and project over mesomeron) and upper area of postmetacoxal membrane. *Legs* (Fig. 1D): Foreleg with paddle of outstanding scales on distal 0.50–0.75 of tibia and spot of white scales on dorsal surface of tarsomere 2, tarsomere 1 often with semierect scales giving shaggy appearance or forming small paddle, tarsomere 3 occasionally with few pale scales posteriorly; midleg as in *Sa. gymnothorax* but tarsus with lesser amount of white scaling, covering all of tar-

somere 2 and variable portion of tarsomere 3, the latter normally narrowly dark-scaled on most of dorsal surface, often narrowly dark ventrally and usually dark distally; hindleg without spot of white scales at tip of femur, usually with small paddle of outstanding scales on distal part of tarsomere 1. *Genitalia* (Fig. 3F–J): Tergum VIII (not figured) essentially as in *Sa. gymnothorax*, posterior margin slightly convex. Sternum VIII as illustrated, not significantly broader basally. Tergum IX narrow, posterior margin rather deeply emarginate in middle, setae normally absent. Insula about as wide as long, with 8–13 setae on either side of slight median depression. Postgenital lobe not narrowed distally, distal 0.6 with rather broad flat lobule on either side of deep median cleft, ventral surface of each lobule covered with short flexible setae, dorsal surface of each with slightly longer and sparser flexible setae on distal 0.75; without ventral basomedian patch of minute setae adjacent to upper vaginal lip.

MALE. No obvious distinctions from female except for distinctly thinner proximal flagellomeres of antenna and genital segments of abdomen. *Genitalia* (Fig. 4F–J): Very different from *Sa. gymnothorax* as indicated by the following. Tergum IX lobe with 2–4(3) longer setae in a single row; interlobular bridge narrower and more or less straight, width about 0.5 length between lobes. Gonocoxite distinctly broader in proximal half, length about 1.7 greatest width, apex on mesal side of gonostylus with concentration of only slightly longer setae and scales, tergal surface with 3 long tergomesal setae; basal mesal lobe very nearly rectangular in outline, 2 setae on outer caudal angle are longer and stronger. Gonostylus proportionately shorter, little more than 0.8 length of gonocoxite; stem relatively stout and generally straight, about 0.5 total length; head as figured, lobe E apparently not developed, although it may be an undifferentiated part of lobe A; lobe A laterally flattened and roughly polygonal in mesal view, free margin with 2 obtuse angles and 3 rather straight edges, a small seta borne on outer (lateral) side of lobe near middle of tergal edge, tergoapical edge with

row of stout short setae, sternoapical edge with row of longer setae which become progressively flattened and broader toward base of lobe; lobe **B** a rather broad compressed thumblike process projecting from middle of inner (mesal) side at base of lobe **A**, distally covered with minute spicules and bearing a row of stout short setae on sternal surface; lobe **C** a rather long armlike process with a dense cluster of long slender retrorse spicules on inner (mesal) side at apex, also bearing a large retrorse membranous flap on distal portion of sternal margin which also has a recurved hairlike fringe at tip, base of lobe with a small retrorse spinelike process on inner (mesal) side; lobe **M** an apically directed lobe borne sternolaterad of lobe **A**, apex with 3 separate digiform processes, mesal process long and slender with hooked tip, lateral process shorter and stouter with small retrorse spinelike projection on middle of tergal margin, median process larger but not longer than lateral process and bearing several stout short setae at apex which transition into a row of progressively longer flat flexible attenuate setae on sternal margin. Aedeagus oval in tergal view, distinctly longer than wide; apical tergal arms more closely approximated. Proctiger with broader basal sclerotization (tergum **X**); paraproct with 1-4(2) minute cercal setae.

Larva (Fig. 7). Character and positions of setae as figured; numbers of branches in Table 3; in general like *Sa. gymnothorax* but with the following conspicuous differences. **Head**: Length 0.72-1.04 mm (mean 0.98 mm); width 1.15-1.48 mm (mean 1.25 mm). Maxilla (Fig. 8) short and nearly as broad as long; apical tooth short and only slightly curved mesad; mesal teeth rather conical, in strongly arched row with largest tooth about 0.4 length of apical tooth. Mandible as figured (Fig. 6). Dorsomentum with 7-9 (mode 8) teeth on either side of median tooth, most lateral tooth not noticeably larger than the other teeth. Anterior margin of labiogula with few barely perceptible tubercles; hypostomal suture incomplete, extending only about one-third distance from postcoila to posterior tentorial pit. Seta 6-C inserted closer to 5-C than 7-C; 14-

C much larger and stronger than other cranial setae, distinctly longer than antenna; 15-C much shorter than 14-C, with 3-8(6) thin branches. **Antenna**: Cylindrical, without small triangular projections on inner side at apex; length 0.28-0.36 mm (mean 0.32 mm). **Thorax**: Plates bearing setae 4- and 5-7-P without prominent spinelike processes. Seta 11-P,M,T very stout, with several to many sharply pointed apical spicules. Seta 1-M with 3-5 branches, often triple; 8-M present (absent on one side in 5 of 12 specimens examined); 13-M much smaller than 8-P, developed like 14-M. Seta 13-T longer, about 0.8 length of thorax. **Abdomen**: Seta 3-I,II short, with multiple branches; 5-II-VI usually triple, sometimes double (5-IV with 4 branches on one specimen examined), 5-V,VI without basal plate, 5-VII very small, multibranching and slightly ventrad of seta 4; 4-III,IV multibranching, developed like 4-I,II,V; 4-IV,V not on plate with seta 5; 4,5-VII not on plate with seta 3; 7-III normal, small, with numerous fine branches; 13-III-V multibranching and stellate; 10-VII short, with 9-16(12) fine branches; 12-IV slightly mesad of seta 13. **Segment VIII**: Comb with 7-18 (mode 12) scales in single or partial double row, individual scales with finer, more numerous lateral spicules. Setae 2,4,5-VIII much shorter than seta 1; 5-VIII not so close to seta 4, distinctly farther ventrad. **Siphon**: Longer, length 1.04-1.33 mm (mean 1.13 mm); width at base 0.32-0.46 mm (mean 0.39 mm); index 2.39-3.33 (mean 2.91). Pecten with 16-59 filaments, extending from slightly above insertion of seta 1-S to a point slightly below insertion of seta 1a-S. Seta 1-S inserted about 0.25 or less from base; 2a-S represented by 2 setae, both proximal to 1a-S; 1a-S borne very near to apical margin of siphon. **Segment X**: Saddle length 0.20-0.24 mm, extending to or very near lateral midline; siphon/saddle index 4.8-5.5 (mean 5.1).

Pupa (Fig. 8). Character and placement of setae as figured; numbers of branches in Table 4; differs conspicuously from *Sa. gymnothorax* in the following. **Cephalothorax**: Lightly to moderately tanned, somewhat

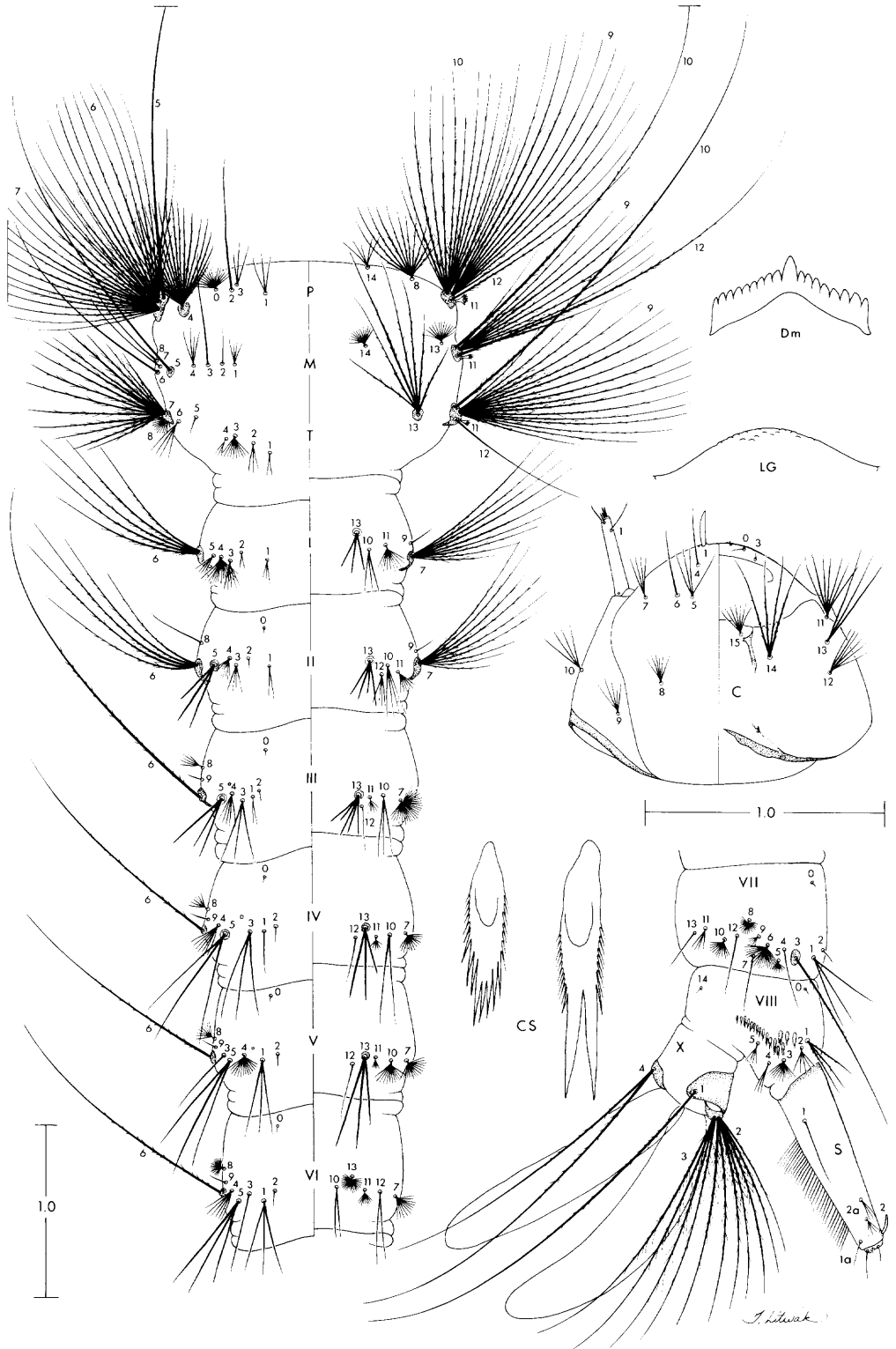


Fig. 7. *Sabethes tarsopus*, fourth-instar larva. Scales in mm.

Table 3. Numbers of branches for fourth-instar larval setae of *Sabethes tarsopus*.

Seta no.	Head C	Thorax			Abdominal segments		
		P	M	T	I	II	III
0	1	9-18(13)	—	—	—	1	1
1	1	2,3(2)	2-5(3)	1-3(2)	2-4(3)	1-3(2)	1,2(2)
2	—	1	1	1-3(3)	1,2(1)	1,2(1)	1
3	1	2,3(2)	1	5-11(10)	3-5(4)	2-5(4)	2-5(3)
4	1	16-20(17)	2-5(4)	2-4(3)	10-14(13)	7-15(7)	2-6(4)
5	3-5(4)	1	1	1	3-5(3)	2,3(3)	2,3(2)
6	1	8-14(11)	1	2-5(3)	3-5(5)	4,5(4)	1
7	3,4(3)	14-18(17)	1,2(1)	9-16(13)	5-9(7)	7-9(7)	10-32(15)
8	4-8(4)	7-12(8)	1,2(1)	10-16(14)	—	1	5-9(8)
9	4-6(4)	9-11(10)	6-11(9)	13-17(15)	1,2(1)	1	1
10	2-4(3)	11-18(11)	1	1	2-4(2)	3-5(3)	2,3(2)
11	4-10(6)	3-6(3)	4-7(4)	4-11(8)	4-15(11)	5-10(6)	5-9(6)
12	4-8(6)	1	1	1	—	3-6(6)	1
13	2-4(2)	—	10-20(14)	6-10(9)	2-4(4)	3-5(4)	4,5(4)
14	3,4(3)	3-5(3)	12-19(18)	—	—	—	—
15	3-8(6)	—	—	—	—	—	—

Seta no.	Abdominal segments					
	IV	V	VI	VII	VIII	X
0	1	1	1	1	1	—
1	1	3,4(3)	3,5(3)	3	3-5(3)	1
2	1	1	1	1,2(1)	3-7(4)	5-7(6)
3	3,4(3)	1	1	1	9-18(13)	3,4(3)
4	5-11(7)	9-15(13)	5-8(8)	1	1-4(2)	2
5	3,4(3)	2,3(3)	2,3(3)	7-9(8)	3-5(4)	—
6	1,2(1)	1	1	14-21(15)	—	—
7	12-15(12)	13-23(17)	9-14(12)	1	—	—
8	3-8(5)	6-10(8)	16-24(22)	18-33(24)	1-S	1
9	1	1	1	5-8(6)	1a-S	1-3(2)
10	1-3(1)	8-12(9)	1-3(2)	9-16(12)	2a-S	3-5(3,4)
11	5-8(6)	4-8(5)	7-10(8)	4-8(4)	—	—
12	1	1	2	1	—	—
13	3	3	21-35(27)	1	—	—
14	—	—	—	—	1	—
15	—	—	—	—	—	—

darker dorsally. Seta 4b-CT occasionally present; 8-CT usually with 3 or 4 branches and distinctly shorter than 9-CT; 10,12-CT with more branches, 10-CT more than half length of 11,12-CT. *Trumpet*: Length 0.50-0.73 mm (mean 0.65 mm); pinna 0.12-0.27 mm (mean 0.22 mm); index 3.1-4.4 (mean 3.7). *Abdomen*: Length 4.1-5.5 mm (mean 5.0 mm). Setae 6,7-I much shorter but ratio of lengths about the same, 6-III-VI always single; 1-II branched at base; 5-III developed like 5-IV-VI; 3-IV developed like 4-V rather than 3-V,VI; 12-VI,VII and alveoli of 13-VI,VII usually present (a single seta 13-VI present on

one side of one specimen examined). *Genital lobe*: Length about 0.40 mm in female, about 0.72 mm in male. *Paddle*: More or less asymmetrical, outer part much larger than inner part; length 0.76-0.92 mm (mean 0.85 mm); width at widest point 0.56-0.65 mm (mean 0.60 mm); index 1.19-1.61 (mean 1.41).

Taxonomy. *Sabethes tarsopus* belongs to a group of species which includes *Sa. belisarioi* Neiva, *Sa. shannoni* Cerqueira, and *Sa. ortizi*, recognized here as the Belisarioi Group. With the exception of *Sa. tarsopus*, these species are so poorly known that they can be distinguished with certainty only by features of the

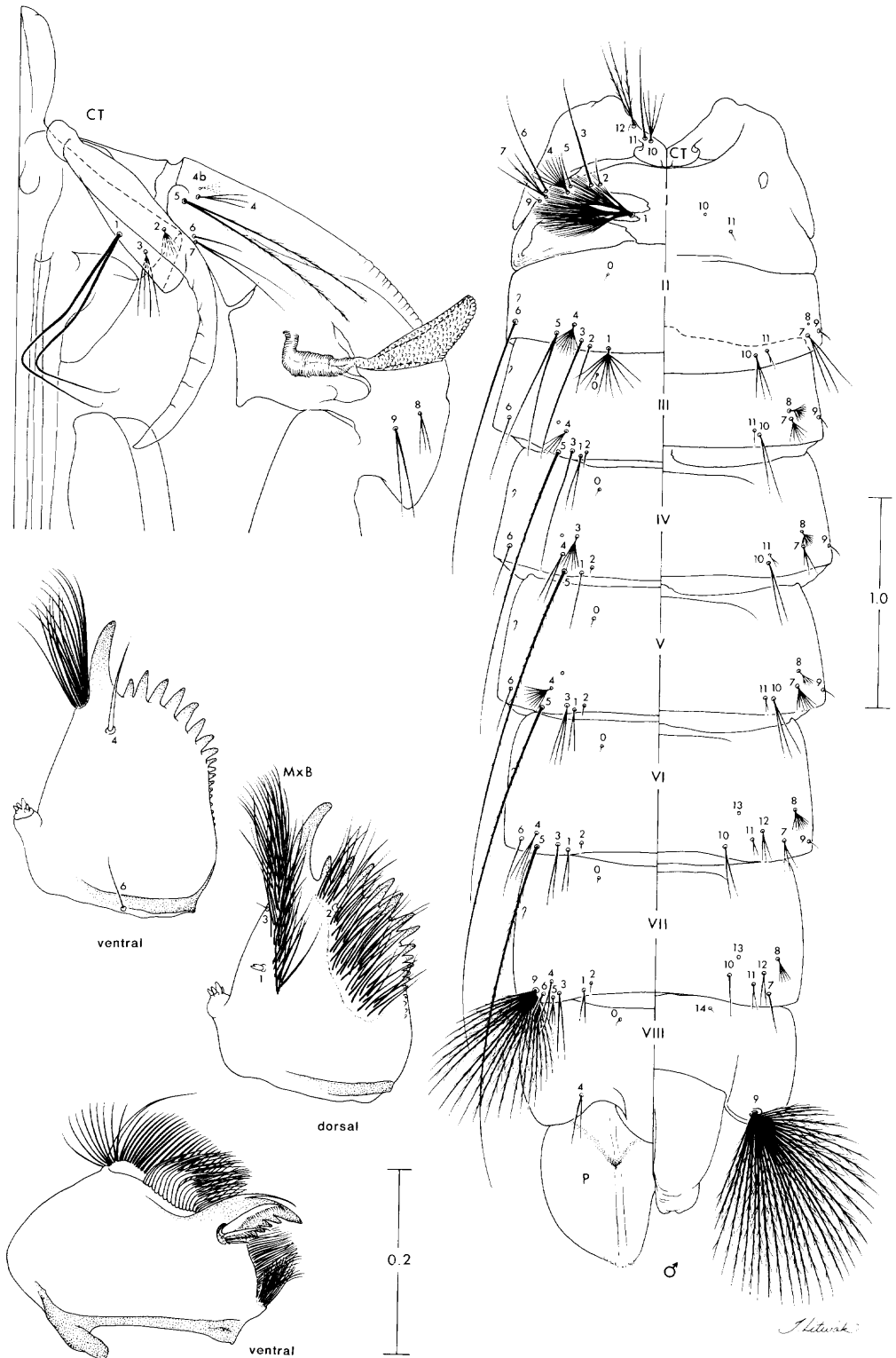


Fig. 8. *Sabethes tarsopus*, pupa and mouthparts of fourth-instar larva. Scales in mm.

Table 4. Numbers of branches for pupal setae of *Sabethes tarsopus*.

Seta no.	Cephalothorax CT	Abdominal segments			
		I	II	III	IV
0	—	—	1	1	1
1	2	49-76	4-9(9)	2-6(2)	2-6(3)
2	4-7(4)	1	1	1	1
3	3-5(5)	1-3(1)	1	1-3(1)	5-11(7)
4	2-4(2)	10-15(11)	7-15(10)	3,4(4)	1,2(1)
5	1-4(3)	1	1-4(3)	1	1
6	1	1	1	1	1
7	2-4(2)	2-5(3)	2-7(3)	3-8(8)	2-4(2)
8	2-6(3,4)	—	—	6-16(10)	3-8(5)
9	2	1,2(1)	1	1	1
10	2-5(4)	—	3-6(4)	1-5(2)	2,3(2)
11	1	1	1,2(1)	1-3(1)	1-3(1)
12	2-4(4)	—	—	—	—
13	—	—	—	—	—
14	—	—	—	—	—

Seta no.	Abdominal segments					Paddle P
	V	VI	VII	VIII	IX	
0	1	1	1	1	—	—
1	1-4(2)	2-4(3)	1-3(1)	—	—	—
2	1	1	1	—	—	—
3	2-4(3)	2-4(3)	1,2(1)	—	—	—
4	7-12(9)	3-7(4)	2	2-4(3)	—	—
5	1	1,2(1)	2-8(3)	—	—	—
6	1	1	2-5(4)	—	—	—
7	8-19(12)	2-4(3)	1-3(2)	—	—	—
8	3-7(6)	10-18(13)	4-8(7)	—	—	—
9	1	1	14-25(24)	27-35(33)	—	—
10	2-5(4)	2-4(3)	1,2(1)	—	—	—
11	1-3(2)	1-3(2)	2-4(3)	—	—	—
12	—	3,4(4)	2,3(2)	—	—	—
13	—	—	—	—	—	—
14	—	—	—	1	—	—

male genitalia. As mentioned earlier, the male genitalia of *Sa. ortizi* are so similar to those of *Sa. tarsopus* that *Sa. ortizi* may represent nothing more than a variant of *Sa. tarsopus*. The larval and pupal stages of *Sa. shannoni* are known from the original species description (Cerqueira 1961), but it is not certain at this time what features may distinguish them from *Sa. tarsopus*. The descriptions and illustrations provided by Cerqueira are inadequate for critical comparison.

Bionomics. We are unaware of any biological characteristics that distinguish *Sa. tarsopus* from *Sa. gymnothorax*. The information given for *Sa. gymnothorax* applies to both species. Neither species has been col-

lected as larvae or pupae and their habitats are unknown.

Distribution. At present, *Sa. tarsopus* is definitely known only from Panama and Costa Rica. Specimens were not available to confirm reports of this species in Nicaragua (Galindo and Trapido 1957) and Guatemala (de Rodaniche and Galindo 1957, Clark-Gil and Darsie 1983). Previous records for Belize, Honduras, and Mexico based on voucher specimens in the NMNH actually pertain to *Sa. gymnothorax*. Knight and Stone (1977) included El Salvador in the distribution of this species, but this does not appear to be a valid country record because it is likely based on Aguilar (1931) who only suspected that

Sa. tarsopus occurred there. No attempt was made to confirm existing records for countries in South America, mainly due to the lack of adequate material.

Material examined. 126 specimens (24♀, 38♂, 5♀ genitalia, 36♂ genitalia, 12 larval exuviae, 11 pupal exuviae), including 11 individual larval rearings. COSTA RICA. Limon, Madre de Dios, Finca La Lola, 40 m, 24 Jul 63, CH, 1♀ (CR 162) (flying in cacao plantation, 1100 h, hot, humid, cloudy). PANAMA. *Bocas del Toro*: Almirante, milla 2, 10 m, 30 Apr 63, AQ, 1♀ (PA 294) (resting in secondary growth, 1100–1400 h). Punta de Pena, "Chiriquicito," 30 m, 21 Apr 63, AQ, 2♀, 2♀ genitalia (PA 247) (attracted to man in forest, 12 m above ground, 1100–1400 h); unknown locality, 28 Sep 03, P. Osterhout, 1♀, 1♀ genitalia (10413, lectotype). *Darien*: Santa Fe, 7.II.85, ACC 1172, 3♂, 3♂ genitalia; ACC 1518, 8♀, 1LePe♂ (PA-SF-031-10), 1LePe♀ (PA-SF-031-11), 1Le (PA-SF-031-12); 15.IV.85, ACC 1518, 2LePe♀ (PA-SF-031-13, -14). Panama: Bayano Reservoir, Majé Island (9° 07' N 78° 51' W), Jan 85, ACC 1518, 3LePe♀ (PA-ST-02-10, -12, -14), 3LePe♂, 3♂ genitalia (PA-ST-02-11, -15, -16), 1LePe♂ (PA-ST-02-13); 4.XII.85, 1♂, 1♂ genitalia (106617); 5.XII.85, 2♂, 2♂ genitalia (106620(1), 106620(2)); 12.12.85, 1♂, 1♂ genitalia (PA-MAJ-04-10); Nov 85-Feb 86, 13♂, 13♂ genitalia (106573-1 through -6, 106754, 106755, 106760, 106839-1 through -3, 106842); 7.01.86, 6♂, 6♂ genitalia (106710-1 through -6); 8.01.86, 1♂, 1♂ genitalia (106720); 9.01.86, 1♂, 1♂ genitalia (106724-1, -2). Cerro Campana (about 4 km N of Chica), 700 m, 28 Aug 63, AQ, 1♀ (9538) (attracted to man in forest), 18 m above ground, 1000–1400 h). Rio Chagres, Juan Mina, VII.58, Duret, 7♂, 7♂ genitalia (5807 through 5812, 5839). *Province unknown*: Juan Diaz, 24 Jan 49, 4♀, 2♀ genitalia.

The specimens from Darien Province and Majé Island represent wild-caught adults and individually reared progeny from wild-caught females collected and processed as indicated in the materials and methods. Two individually reared specimens (PA-ST-01-10, -13) are deposited in the Natural History Museum,

London. The other specimens are located in the NMNH.

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REFERENCES CITED

- Adames, A.J., P.H. Peralta, R. Saenz, C.M. Johnson and P. Galindo. 1979. Brote de encefalomiелitis equina venezolana (VEE) durante la formacion del Lago Bayano, en Panama, 1977. *Rev. Med. Panama* 4:246–257.
- Aguilar, S.G. 1931. Claves para identificar mosquitos en El Salvador. Tesis de Doctorado en Medicina. San Salvador, El Salvador, C.A.
- Belkin, J.N., S.J. Heinemann and W.A. Page. 1970. The Culicidae of Jamaica. (Mosquito studies. XXI). *Contrib. Am. Entomol. Inst. (Ann Arbor)* 6(1):1–458.
- Belkin, J.N., R.X. Schick and S.J. Heinemann. 1965. Mosquito studies (Diptera, Culicidae) V. Mosquitoes originally described from Middle America. *Contrib. Am. Entomol. Inst. (Ann Arbor)* 1(5):1–95.
- Bertram, D.S. 1971. Mosquitoes of British Honduras, with some comments on malaria, and on arbovirus antibodies in man and equines. *Trans. R. Soc. Trop. Med. Hyg.* 65:742–762.
- Bonne, C. and J. Bonne-Wepster. 1925. Mosquitoes of Surinam, a study on neotropical mosquitoes. *Meded. K. Inst. Amst.* 21 (*Trop. Hyg.*) 13:1–558, 13 pl.
- Cerqueira, N.L. 1961. Cinco novos sabetinos

- da Amazônia (Diptera Culicidae). Rev. Bras. Entomol. 10:37-52.
- Clark-Gil, S. and R.F. Darsie, Jr. 1983. The mosquitoes of Guatemala. Their identification, distribution and bionomics, with keys to adult females and larvae in English and Spanish. Mosq. Syst. 15:151-284.
- Cova Garcia, P., E. Sutil and J.A. Rausseo. 1966. Mosquitos de Venezuela. Vol. 1. Ministerio de Sanidad y Asistencia Social, Caracas.
- da Costa Lima, A. 1931. Sobre as especies dos generos *Sabethes* e *Sabethoides* (Diptera: Culicidae). Mem. Inst. Oswaldo Cruz Rio De J. 25:51-64, 3 pl.
- de Rodaniche, E. and P. Galindo. 1957. Isolation of yellow fever virus from *Haemagogus mesodentatus*, *H. equinus* and *Sabethes chloropterus* captured in Guatemala in 1956. Am. J. Trop. Med. Hyg. 6:232-237.
- Díaz Nájera, A. 1966. Mosquitos tropicales de Mexico. Rev. Invest. Salud Publica 26:57-64.
- Díaz Nájera, A. and L. Vargas. 1973. Mosquitos mexicanos. Distribución geográfica actualizada. Rev. Invest. Salud Publica 33:111-125.
- Dyar, H.G. 1919. A revision of the American Sabethini of the *Sabethes* group by the male genitalia (Diptera, Culicidae). Insec. Inscit. Menst. 7:114-142.
- Dyar, H.G. 1923. The mosquitoes of Panama (Diptera, Culicidae). Insec. Inscit. Menst. 11:167-186.
- Dyar, H.G. 1924. A note on *Sabethes* Robineau-Desvoidy (Diptera, Culicidae). Insec. Inscit. Menst. 12:97-100.
- Dyar, H.G. 1925. The mosquitoes of Panama (Diptera, Culicidae). Insec. Inscit. Menst. 13:101-195.
- Dyar, H.G. 1928. The mosquitoes of the Americas. Part 1. Carnegie Inst. Wash. Publ. 387:1-616.
- Dyar, H.G. and F. Knab. 1908. Descriptions of some new mosquitoes from tropical America. Proc. U.S. Nat. Mus. 35:53-70.
- Forattini, O.P. 1965. Entomologia médica. Vol. 3. Culicini: *Haemagogus*, *Mansonia*, *Culiseta*. Sabethini. Toxorhynchitini. Arboviruses. Filariose bancroftiana. Genética. Universidade de São Paulo, São Paulo.
- Forattini, O.P. and A. Toda. 1967. Notas sobre Culicidae (Diptera), 10. Novo encontro e alguns dados sobre as formas imaturas de *Sabethes forattinii*. Rev. Bras. Entomol. 12:103-107, 2 pl.
- Galindo, P. 1973. Experiencias epidemiológicas en el Proyecto Bayano. Plerus 7:81-89.
- Galindo, P. and H. Trapido. 1955. Forest canopy mosquitoes associated with the appearance of sylvan yellow fever in Costa Rica, 1951. Am. J. Trop. Med. Hyg. 4:543-549.
- Galindo, P. and H. Trapido. 1957. Forest mosquitoes associated with sylvan yellow fever in Nicaragua. Am. J. Trop. Med. Hyg. 6:145-152.
- Galindo, P., S.J. Carpenter and H. Trapido. 1951. Descriptions of two new species of *Wyeomyia* and the male of *Sabethes tarsopus* Dyar and Knab. Proc. Entomol. Soc. Wash. 53:86-96.
- Galindo, P., S.J. Carpenter and H. Trapido. 1955. A contribution to the ecology and biology of tree hole breeding mosquitoes of Panama. Ann. Entomol. Soc. Am. 48:158-164.
- Galindo, P., E. de Rodaniche and C.M. Johnson. 1959. St. Louis encephalitis in Panama 1. Isolation of the virus from forest mosquitoes and human blood. Am. J. Trop. Med. Hyg. 8:557-560.
- Galindo, P., A.J. Adames, P.H. Peralta, C.M. Johnson and R. Read. 1983. Impacto de la hidroeléctrica de Bayano en la transmisión de arbovirus. Rev. Med. Panama 8:89-134.
- Hancock, R.G., W.A. Foster and W.L. Yee. 1990. Courtship behavior of the mosquito *Sabethes cyaneus* (Diptera: Culicidae). J. Insect Behav. 3:401-416.
- Harbach, R.E. and K.L. Knight. 1980. Taxonomists' glossary of mosquito anatomy. Plexus Publishing, Inc., Marlton, New Jersey.
- Harbach, R.E. and K.L. Knight. 1982. Corrections and additions to *Taxonomists'*

- glossary of mosquito anatomy*. Mosq. Syst. (1981) 13:201-217.
- Heinemann, S.J. and J.N. Belkin. 1977a. Collection records of the project "Mosquitoes of Middle America" 7. Costa Rica (CR). Mosq. Syst. 9:237-287.
- Heinemann, S.J. and J.N. Belkin. 1977b. Collection records of the project "Mosquitoes of Middle America" 8. Central America: Belize (BH), Guatemala (GUA), El Salvador (SAL), Honduras (HON), Nicaragua (NI, NIC). Mosq. Syst. 9:403-454.
- Heinemann, S.J. and J.N. Belkin. 1977c. Collection records of the project "Mosquitoes of Middle America" 9. Mexico (MEX, MF, MT, MX). Mosq. Syst. 9:483-535.
- Heinemann, S.J. and J.N. Belkin. 1978. Collection records of the project "Mosquitoes of Middle America" 10. Panama, including Canal Zone (PA, GG). Mosq. Syst. 10:119-196.
- Holdridge, L.R. and G. Budowski. 1956. Report of an ecological survey of the Republic of Panama. Caribb. For. 17:92-110.
- Howard, L.O., H.G. Dyar and F. Knab. 1915. The mosquitoes of North and Central America and the West Indies. Vol. 3. Systematic description (in two parts). Part 1. Carnegie Inst. Wash. Publ. 159:1-523.
- Knight, K.L. and A. Stone. 1977. A catalog of the mosquitoes of the world (Diptera: Culicidae). Second edition. Thomas Say Found. 6:xi + 1-611.
- Lane, J. 1953. Neotropical Culicidae. Vol. II. University of São Paulo, São Paulo.
- Lane, J. and O.R. Causey. 1955. Additional data on Sabethini (Diptera, Culicidae). Proc. Entomol. Soc. Wash. 57:11-17.
- Martini, E. 1935. Los mosquitos de México. Bol. Tec. Dep. Salubr. Publica Ser. A Entomol. Med. Parasitol. 1:1-65.
- Palacios, F.C.M. 1987. Los mosquitos de México (Diptera: Culicidae) taxonomia, distribucion geografica y su importancia en salud publica. Tesis, licenciado en biologia, Facultad de Ciencias Biologia, Universidad Nacional Autonoma de Mexico, Mexico, D.F.
- Read, R.G. 1977. Microclimate as background environment for ecological studies of insects in a tropical forest. J. Appl. Meteorol. 16:1282-1291.
- Read, R.G. and A.J. Adames. 1980. Atmospheric stimulation of man-biting activity in tropical insects. Environ. Entomol. 9:677-680.
- Read, R.G., A.J. Adames and P. Galindo. 1978. A model of microenvironment and man-biting tropical insects. Environ. Entomol. 7:547-552.
- Stone, A. and K.L. Knight. 1957. Type specimens of mosquitoes in the United States National Museum, V: the Sabethini (Diptera, Culicidae). J. Wash. Acad. Sci. 47:117-126.
- Vargas, L. and A. Díaz Nájera. 1959. Descripción del macho de *Sabethes (Sabethes) belisarioi* Neiva, 1908. Nueva especie para México (Insecta: Diptera). Rev. Inst. Salubr. Enferm. Trop. 19:299-308.
- Vargas, L. and A. Díaz Nájera. 1961. Nueva especie de *Sabethes* de México (Diptera, Culicidae). Rev. Inst. Salubr. Enferm. Trop. 21:73-77.
- Wali, A. 1989. Kilowatts and crisis. Hydroelectric power and social dislocation in eastern Panama. Westview Press, Boulder, Colorado.