

A New Species of *Toxorhynchites* from Papua New Guinea  
(Diptera: Culicidae)<sup>1, 2</sup>

Wallace A. Steffan and Neal L. Evenhuis  
Department of Entomology, Bishop Museum  
P. O. Box 19000-A  
Honolulu, Hawaii 96819

ABSTRACT. The male, female, pupa and larva of *Toxorhynchites* (*Toxorhynchites*) *nepenthicola* n. sp. are described and illustrated. The adults were bred from larvae collected in *Nepenthes* pitchers in the Upper Fly River area of Papua New Guinea.

#### INTRODUCTION

The following description of the new species *Toxorhynchites* (*Toxorhynchites*) *nepenthicola* incorporates the format and methodology to be used in a forthcoming monographic study of *Toxorhynchites*. All morphological or morphometric characters used in this study are detailed in each species description, which includes a verbal description of the male, female, pupa and 4th instar larva, line drawings of portions of the adult, the pupa and 4th instar larva, and tables showing the range of variation for all setae on the pupa and 4th instar larva.

The descriptions of *Tx. nepenthicola* are entered into a word processor and stored on a disc. The same format, with the modifying adjectival phrases for each character deleted and replaced by blank spaces, is used as a basis for all subsequent descriptions of *Toxorhynchites* species. This format ensures that all characters used in the study are examined and recorded for each species. The complete description, especially since the same format is to be used on all other species, should provide more information to either the reader identifying a particular species or to other researchers using this data base for analytical purposes.

Terminology follows Harbach and Knight (1980); however, we are following McAlpine (1981:10) and Mackerras (1970:4) in the use of terms relating to orientation and relationship of parts of structures; i.e., basal medial lobe rather than basal mesal lobe. Chaetotaxy tables for the 4th larva and pupa follow Tanaka, Mizusawa and Saugstad (1979) with slight modifications.

---

<sup>1</sup>Contribution from the project "Biosystematics of *Toxorhynchites*" supported by the National Institutes of Health Grant AI-12168.

<sup>2</sup>Specimens examined in this study are the partial results of fieldwork supported by the National Institutes of Health Grant AI-07917.

Specimens examined in this study were collected during the Bishop Museum's study "Mosquitoes of the Papuan Subregion." Collection records and related field data are kept on 5 x 8 inch collection data cards on file in the Entomology Department of the Bishop Museum. All specimens examined in this study, except one paratype to be deposited in the U. S. National Museum, are deposited in the Bishop Museum (BPBM).

In this study (collections BBMC #69-796-BBMC #69-874) 79 pitchers were sampled. All were ground pitchers 0.03-0.05 meters above the ground. The *Nepenthes* was not identified but was possibly *Nepenthes ampullaria* Jack. Eighteen percent of these pitchers contained *Toxorhynchites*, and in only one sample was there more than 1 larva. Fourteen percent contained other culicid larvae including a *Tripteroides (Rachisoura)* species. Fifty-four percent of the pitchers contained only fragments of insects.

*Toxorhynchites (Toxorhynchites) nepenthicola* Steffan & Evenhuis, n. sp.

MALE (Fig. 1). *Wing*: Length 6.4-6.8 mm (3 specimens). *Head*: Vertex, viewed dorsally, with metallic, bluish-green spatulate scales, ocular line narrow, broadening slightly near postgena, scales silvery-white; forked scales dark; ocular setae (4 pairs) brown, medial pair 2 x as long as lateral setae 3-4. Proboscis and maxillary palpus (MPlp) purplish dorsally, apical silvery-white scales on MPlp<sub>2</sub> pale at sublateral angle, MPlp<sub>3</sub> with median silvery-white area laterally and ventrally; short, dark setae on apex of MPlp<sub>2+3</sub>, one row of moderately long setae (as long as diameter of palpomere) at anteroventral and posteroventral angle of MPlp<sub>4</sub>, numerous short, black setae at anteroventral and posteroventral angles of MPlp<sub>5</sub>; length of MPlp<sub>2+3</sub> 2.4 mm, MPlp<sub>4</sub> 1.6 mm, MPlp<sub>5</sub> 2.8 mm. *Antenna*: Pedicel (Pe) tomentous with some dorsal white scales; flagellomere 1 (Flm<sub>1</sub>) 0.54 mm long with dense, dark dorsal scales at base of flagellar whorl (FW<sub>1</sub>), scales translucent medially; Flm<sub>2</sub> 0.16 mm long; sparse, dark scales at base of FW<sub>2</sub>, FW<sub>3</sub> and occasionally FW<sub>4</sub>, Flm<sub>5+12</sub> without scales at base of each FW; flagellar whorls dense with 30+ setae. Clypeus tomentous.

*Thorax*: Scutum and anterior promontory (AnP) with brownish fusiform scales appearing bluish-purple when viewed from an angle; supraalar area with greenish-blue spatulate scales. Scutellum (Stm) with brownish spatulate scales appearing bluish-green when viewed at an angle, scutellar setae brown. Paratergite bare. Anteprepronotum (Ap) with brownish spatulate scales appearing bluish when viewed at an angle, scales along ventral edge silvery-white. Postpronotum (Ppn) with silvery-white fusiform scales. Proepisternum (Ps), mesokatepisternum (Mks), and mesanepimeron (Mam) with dense patches of silvery-white spatulate scales; anteroventral portion of Mks and mesomeron (Msm) with aculeae only; posteroventral angle of Mam bare. Pleural setae white; 2-3 lateral Mam setae; scales absent below base of halter. *Legs*: Coxae and trochanters with dense patches of silvery-white spatulate scales and numerous fine, white setae; Coxa I with 2-3 strong, brown lateral setae; Coxa II with 4 brown lateral setae; Coxa III with 3 brown lateral setae and a row of strong, yellowish mesal setae. Femora with metallic purple scales dorsally, with yellow to golden scales ventrally, scales becoming progressively broader on mid and hind femur, especially basally. Tibiae with purple scales. Tarsomeres (Ta) with purple scales except for weakly defined pale band on basal 1/3 of TaII<sub>1</sub>; TaIII<sub>1</sub> with well defined

but weak ventral brush on basal 1/5th. *Wing*: Costa and vein  $R_1$  with purple spatulate scales, some bluish highlights, other wing scales brownish; radio-medial (rm) crossvein with longitudinal portion 3 x as long as transverse portion; transverse portion of  $M_{3+4}$  oblique, joining  $M_{1+2}$  at or slightly distad of rm. *Halter*: Pale; pedicel bare; capitellum with brownish spatulate scales becoming pale or golden at apex.

*Abdomen*: Laterotergite with dense patch of silver-white spatulate scales. Tergum (Te) I with bluish spatulate scales dorsally, white laterally, fine, yellowish setae anteriorly, becoming denser anterolaterally, lateral pale, fine setae lighter and longer, posterior margin with single row of white, fine setae. Terga II-VII with dark spatulate scales appearing purplish from above. Terga II-V with lateral patch of white scales becoming progressively narrower on each posterior tergum, usually single row of lateral, yellowish-white fine setae with small setal patch at each posterolateral corner, becoming progressively larger on each posterior tergum. Lateral setae on VI-VIII-Te modified, forming a distinct caudal tuft, setae of equal thickness almost to apex and on VII-Te, VIII-Te and posterior 2/3 of VI-Te, arranged in 8-15 lateral rows; lateral setae of VI-Te pale on anterior 1/3-1/4, black and much denser on posterior 2/3-3/4; lateral setae of VII-Te black and of uniform high density; lateral setae of VIII-Te yellow to orange. Sterna II-VII with purplish medial and shining yellowish lateral scales, dark scales of II-S and III-S on mesal 1/2, slightly broader on IV-S, becoming progressively narrower on V, VI and VII-S, VII-S with purplish scales; lateral setae sparse, pale anteriorly, becoming darker posteriorly, long, light brown to dark seta along posterior margin of II-VIII-S.

*Genitalia* (Fig. 3). Length: Gonocoxite (Gc) 0.68-0.69 mm; gonostylus (Gs) 0.64-0.65 mm, gonostylar claw (GC) 0.07-0.08 mm. IX-Te with posterior margin straight, 17-22 lateral, simple setae extending to posterior angle. Gc with numerous fine medial setae generally sharply curved apically. Basal medial lobe (BML) with 2 stout apical setae, lengths, 0.16 mm and 0.23 mm., respectively, remainder of medial surface of BML densely covered with simple setae, approximately 1/2 length of longest apical BML setae. Gs with subapical acute gonostylar claw, medial margin of Gs with numerous minute setulae extending from apex to near base. Proctiger with paired paraproct, each sclerotized apically forming simple spur, with 2-3 subapical cercal setae. Aedeagus with narrow dorsal aedeagal bridge; basal piece and paramere as illustrated.

*FEMALE* (Fig. 2). *Wing*: Length 5.8-6.2 mm (5 specimens). *Head*: With bluish-green spatulate scales, ocular line pale, broadening near postgena; forked scales dark; ocular setae brown, medial pair 2 x as long as lateral setae 3-4 (one short seta between 2nd and 3rd lateral setae, 1st pair = medial pair). Proboscis and  $MPlp$  purplish,  $MPlp_3$  with stout preapical, sublateral setae extending only slightly beyond apex of scales; length of  $MPlp_2$  0.48 mm,  $MPlp_{3-5}$  0.88 mm. *Antenna*: Pedicel (Pe) tomentous with dense, white spatulate scales covering entire dorsal surface and extending laterally and medially to middle of Pe;  $Flm_1$  0.30 mm, with dense patch of pale to light brown dorsal scales at basal half, distal half with short, fine, white hairs,  $Flm_2$  0.28 mm, covered with fine, white hairs,  $Flm_{2-12}$  without scales at base of FW,  $FW_{2-12}$  with 3-5 setae. Clypeus tomentous.

*Thorax:* Scutum and anterior promontory with brownish fusiform scales appearing bluish-purple when viewed from an angle (some silvery-white scales on anterior edge), supraalar area with bluish spatulate scales. Scutellum with brownish spatulate scales appearing bluish-green when viewed at an angle, scutellar setae brown. Paratergite bare. Ap with brownish spatulate scales appearing bluish when viewed at an angle, scales along ventral margin white. Ppn with silvery-white fusiform scales. Ps and Mam with dense patches of silvery-white spatulate scales; anteroventral portion of Mks and Msm with aculeae only; posteroventral angles of Mam bare. Pleural setae pale, lower Mam setae yellowish, distinctly larger than lateral Mam setae. Small patch of white scales on Mts below base of halter. *Legs:* Coxae and trochanters with dense patches of silvery-white spatulate scales, coxae with numerous fine, white setae; Coxa I with 4-5 strong, brown, lateral setae; Coxa II with 4 slightly brown lateral setae; Coxa III with 3-4 brown lateral setae and row of long, white medial setae. Femora with light purplish scales dorsally, yellow to golden scales ventrally, scales becoming progressively broader on mid and hind femora, especially basally. Tibiae with purple scales. Tarsomeres with purple scales except for white bands on basal 1/3 of TaII<sub>1</sub>, basal 1/3-1/2 of TaII<sub>2</sub> and basal 1/2 of TaIII<sub>2</sub>; TaIII<sub>1</sub> with well defined but weak ventral brush on basal 1/5th. *Wing:* Costa and R<sub>1</sub> with purplish spatulate scales, some bluish highlights, other wing scales brownish; rm crossvein with longitudinal portion almost 3 x as long as transverse portion; transverse portion of M<sub>3+4</sub> oblique, joining M<sub>1+2</sub> slightly distad of rm. *Halter:* Yellowish-white; pedicel bare; capitellum with light brownish spatulate scales becoming pale or golden at apex.

*Abdomen:* Laterotergite with dense patch of silvery-white spatulate scales. Tergum I with bluish spatulate scales dorsally, white laterally; fine, yellowish setae anteriorly, becoming denser anterolaterally, lateral fine white setae becoming denser anterolaterally, lateral setae lighter and longer, posterior margin with single row of white setae. II-VIII-Te with dark spatulate scales appearing purplish from above. II-V-Te with broad lateral patch of white scales, on III-Te visible from above as a slight medial extension, on IV and V-Te slightly narrower than those on II-Te; usually single row of lateral pale, fine setae with small setal patch at posterolateral corner, those setae becoming progressively more extensive on each posterior tergum. Lateral setae on VI-VIII-Te modified, forming a distinct caudal tuft, setae of equal thickness almost to apex and on VII-Te, VIII-Te and posterior 1/2 of VI-Te, arranged in 8-15 lateral rows; lateral setae of VI-Te pale on anterior 2/3, black and much denser on posterior 1/3; lateral setae of VII-Te black and of uniform high density; lateral setae of VIII-Te orange to yellow. II-VII-S with purplish medial and shining yellowish lateral scales; purple scales of II-S on medial 1/5 or less, III-S basally on medial 1/3, narrowing posteriorly to medial 1/4, on IV-S on approximately medial 1/3, on V and VI-S basally on medial 1/3, narrowing posteriorly to 1/4, on VII-S on mesal 1/3, only narrowing near posterior margin; VIII-S dark.

PUPA (Fig. 4, Table 1). *Pigmentation:* Generally light overall; trumpet darker, light brown; abdomen generally uniformly light; paddle light with dark, mottled irregular basal line, midrib darker, fading apically. *Measurements:* Trumpet length 1.25 mm, width 0.33 mm; trumpet index 3.8; pinna 1/3 of trumpet length. Length of abdomen 6.39 mm. Paddle length 1.88 mm, width 1.54 mm; lateral section of paddle extends 0.46 mm beyond medial section. Length of

setae: 6-IV 2.64 mm, 6-VI 2.16 mm, 6-VII 1.75 mm, 5-VII 1.54 mm. *Chaetotaxy*: as illustrated (Fig. 4); range of variation shown in Table 1. Seta 13-CT absent; seta 1-I dendritic with aciculate dendritic branches; setae 6-I-VII (relative lengths) long, extending well beyond posterior margin of the next succeeding segment. Paddle broadly pear-shaped, with apical setae becoming smaller and sparser laterally and medially, lateral section (divided by midrib) considerably larger than medial section, extending well beyond median section.

LARVA (Fig. 5, Table 2). *Pigmentation*: Head, siphon and saddle light brown; spiracular apodeme tapering to apex, yellowish. *Measurements*: Head length 1.46 mm; dorsal apodeme length 1.29 mm, width 1.38 mm; antenna length 0.54 mm; siphon length 0.86 mm, width 0.63 mm; spiracular apodeme length 0.33 mm; anal saddle length 1.04 mm; saddle-siphon index 1.21 mm. *Chaetotaxy*: as illustrated (Fig. 5), range of variation shown in Table 2. Setae 11-I and 10, 12-13-I on two separate plates; seta 4-IV and 3-V forked, not barbed; setae 1, 3-VII both strong, barbed.

TYPE DATA. Holotype male (BBMC 69-809.1) with associated pupal and larval skins on separate slides, PAPUA NEW GUINEA, Western District, Upper Fly River, Olsobip [ $5^{\circ}23'S$   $141^{\circ}31'E$ ] 28.VIII.1969, collected as larva from pitchers [probably *Nepenthes ampullaria*] 0.03 m above ground, partial shade, 580 m elevation, M. Sedlacek (BPBM 12421). Allotype female (BBMC 69-858.1) with associated pupal and larval skins on separate slides, same data as holotype. Paratypes: 1 1pF (BBMC 69-798.1), 1 1pF (BBMC 69-803.1), 1 1pF (BBMC 69-811-1), 1 1pM (BBMC 69-843-1), 1M (BBMC 69-847-1), 1 P (BBMC 69-851), 3 L (BBMC 69-852, 69-855, 69-856), same data as holotype (all in BPBM), 1 1pF (BBMC 69-812-1), same data as holotype (USNM).

DISTRIBUTION. *Toxorhynchites (Toxorhynchites) nepenthicola* is known only from the type locality near Olsobip, in the Star Mountains of Papua New Guinea near the upper Fly River.

TAXONOMIC DISCUSSION. Adults of *Tx. (Tox.) nepenthicola* are similar to *Tx. (Tox.) splendens* and may tentatively be placed in that species group, s. str., based on adult and pupal characters. Larval characters tend to ally it more closely with members of the *Tx. (Tox.) acaudatus* group which also restrict their ovipositing to pitcher plants. A more conclusive placement of this species within the subgenus *Toxorhynchites* will be made after more detailed studies and comparisons with congeners are carried out.

*Tx. (Tox.) nepenthicola* can be separated from *Tx. (Tox.) splendens* and allies by the all purple scaling on abdominal terga II-VII.

BIONOMICS. Larvae of *Tx. (Tox.) nepenthicola* were collected from pitcher plants 0.03-0.05 meters above the ground near Olsobip, Upper Fly River, Papua New Guinea. These immatures were individually reared and the corresponding larval and pupal skins, and emerged adults preserved and each given a unique collection number. Development time for pupae ranged from 8-11 days.

BIOCONTROL POTENTIAL. Since the immature stages of this species are apparently restricted to pitcher plants and subsequent attempts to rear pitcher-plant inhabiting *Toxorhynchites* by us (viz., *Tx. klossi*) in the laboratory were unsuccessful, the biocontrol potential for this species would have to be considered minimal.

#### ACKNOWLEDGMENTS

We wish to thank Dr. Christine Simon for her help in elucidating some of the larval characters used in this study, as well as her review of portions of the manuscript. Special thanks are given to Mr. Mark Thomas for preparing the initial illustrations and Mr. Arthur Kodani for preparing the final illustrated material and Ms. Reidun Johansen-Khan for typing the manuscript. We also wish to acknowledge the excellent field collections and supporting ecological data collected by Maria Sedlacek.

#### LITERATURE CITED

- Harbach, R. E. and K. L. Knight. 1980. Taxonomists' glossary of mosquito anatomy. Plexus Publ., Marlton, New Jersey. xi + 415 pp.
- Mackerras, I. M. 1970. Skeletal anatomy, pp. 3-28. In: Insects of Australia. Melbourne Univ. Press. xiii + 1029 pp.
- McAlpine, J. F. 1981. Morphology and terminology - adults, pp. 9-63. In: McAlpine, J. F. et al., Manual of Nearctic Diptera. Volume 1. Bio-systematics Research Institute, Ottawa. vi + 674 pp.
- Tanaka, K., K. Mizusawa and E. S. Saugstad. 1979. A revision of the adult and larval mosquitoes of Japan (including the Ryukyu Archipelago and the Ogasawara Islands) and Korea (Diptera: Culicidae). Contr. Am. Entomol. Inst. 16:i-vii + 987 pp.

TABLE 1. CHAETOTAXY OF THE PUPA OF *Toxorhynchites (Toxorhynchites) nepenthicola*

No.	CEPHALO- THORAX	ABDOMEN													
		I	II	III	IV	V	VI	VII	VIII	IX	X				
0	-	-	1	1	1	1	1	1	1	1	1	1	-	-	-
1	1(L)	m(d)	9-m(d)	1-3(L)	1(b,L)	1-5(L)	1-3	2-5	-	-	1	6-m	-	-	-
2	1	1	1	1-4	1-2	1-2	1	1	-	-	-	-	-	-	-
3	1-2	1-4	1-4	1-6	5-10	3-7	3-8	2-7	-	-	-	-	-	-	-
4	1-2	4-10	3-10	1-7	5-8	4-7	2-6	1-2	1-2	1-2	-	-	-	-	-
5	2-6	3-8	1-3(b,L)	1-3(b,L)	1(b,L)	1(b,L)	1(b,L)	1-2(b,L)	-	-	-	-	-	-	-
6	3-7	1(b,L)	1-5(b,L)	1(b,L)	1(b,L)	1(b,L)	1(b,L)	1-4(b,L)	-	-	-	-	-	-	-
7	1-4	3-8	3-10	2-4	2-3	3-7	2-7	2-4	-	-	-	-	-	-	-
8	1-3	-	1	1	1	1-2	1-5	5-8	-	-	-	-	-	-	-
9	1	1	1	1	1	1	1	1	1	1	1	-	-	-	-
10	3-4	-	0-1	1-4	1-5	1-4	1-2	1	-	-	-	-	-	-	-
11	1-5	-	1-4	1-2	1	1	1	1	-	-	-	-	-	-	-
12	1-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	0-1	1	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

B = barbed; b = weakly barbed; d = dendritic; L = long; m = multiple (more than 10 branches); sf = stiff

TABLE 2. CHAETOTAXY OF THE 4TH INSTAR LARVA OF *Toxorhynchites (Toxorhynchites) nepenthicola*.

SETA No.	HEAD	ANTENNA				THORAX										ABDOMEN		
		PRO-	MESO-	META-	I	II	III	IV	V	VI	VII	VIII						
0	1	-	8-m	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1-6	1	1	1(B)	1-2(B)	1(B)	1(B)	1(L,B)	1-5	1(B)	1-5	1(L,B)	1-2	1(B)	1-2	1-2	1-2
2	-	1	1-3	1-2	3-9	1-5	1-3	1	1	1	1	1	1	1	1	3-7	3-7	3-7
3	1	1	1-6	1	6-10	2(L,B)	1-3(L,B)	2(L,B)	1-2(L,B)	1(B)	1(B)	1(B)	1-2(L,B)	1-2	1(B)	3-5	3-5	3-5
4	1	1	8-m	1-3	3-m	2(B)	1-2(L,B)	2(L,B)	1-3	1-m	1-5	1-m	1-2(L,B)	1-5	1(sf,B)	1(sf,B)	1(sf,B)	1(sf,B)
5	m	1	1(sf,B)	1(L)	6-m	1-4	5-7	2-7	1-4	3-m	2-5	3-m	1-4	2-5	1(sf,B)	1(sf,B)	1(sf,B)	1(sf,B)
6	1	1	4-m	1(sf,B)	1(sf,B)	2(L,B)	2(L,B)	2(L,B)	1(L,B)	1(L,B)	3-m	1(L,B)	1(L,B)	3-m	1-5	1-5	1-5	1-5
7	1	-	1-2(sf,B)	3-8	1-2(sf,B)	2(L,B)	1-2(L,B)	2(L,B)	1(L,B)	1(L,B)	1-2(L,B)	1(L,B)	1(L,B)	1-2(L,B)	1-2(L,B)	1-2(L,B)	1-2(L,B)	1-2(L,B)
8	1	-	m	m	m	-	1	1	1	1	1	1	1	1	1	1	1	1
9	1-4	-	1(sf,B)	1(sf,B)	1(sf,B)	1-2	1-2	1	1	1	0-1	1	1	0-1	1(sf,B)	1(sf,B)	1(sf,B)	1(sf,B)
10	0-5	-	1(L)	1(L)	1(L)	1	2(B)	2(L,B)	1-2(L,B)	1	1	1	1	1	2-X	2-X	2-X	2-X
11	0-m	-	1-4	0-2	1-2	2(L,B)	2(L,B)	2(L,B)	1-2(L,B)	1(B)	1(L,B)	1(B)	1(L,B)	1(L,B)	4-9(L)	4-9(L)	4-9(L)	4-9(L)
12	3-6	-	1	1	1	9-m	1	1-3	1-4	1-2	1	1-2	1	1	3-X	3-X	3-X	3-X
13	4-7	-	-	1-2(sf,B)	1-2(sf,B)	1(L,B)	1(L,B)	1(L,B)	1(L,B)	1(B)	1(L,B)	1(B)	1(L,B)	1(L,B)	4-5(L)	4-5(L)	4-5(L)	4-5(L)
14	0-1	-	1	m	-	-	-	-	-	-	-	-	-	-	4-X	4-X	4-X	4-X
15	0-1	-	-	-	-	-	-	-	-	-	-	-	-	-	7-10(B)	7-10(B)	7-10(B)	7-10(B)
6-M <sub>x</sub>	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

B = barbed; b = weakly barbed; d = dendritic; L = long; m = multiple (more than 10 branches); sf = stiff.



**Fig. 1**

*nepenthicola*

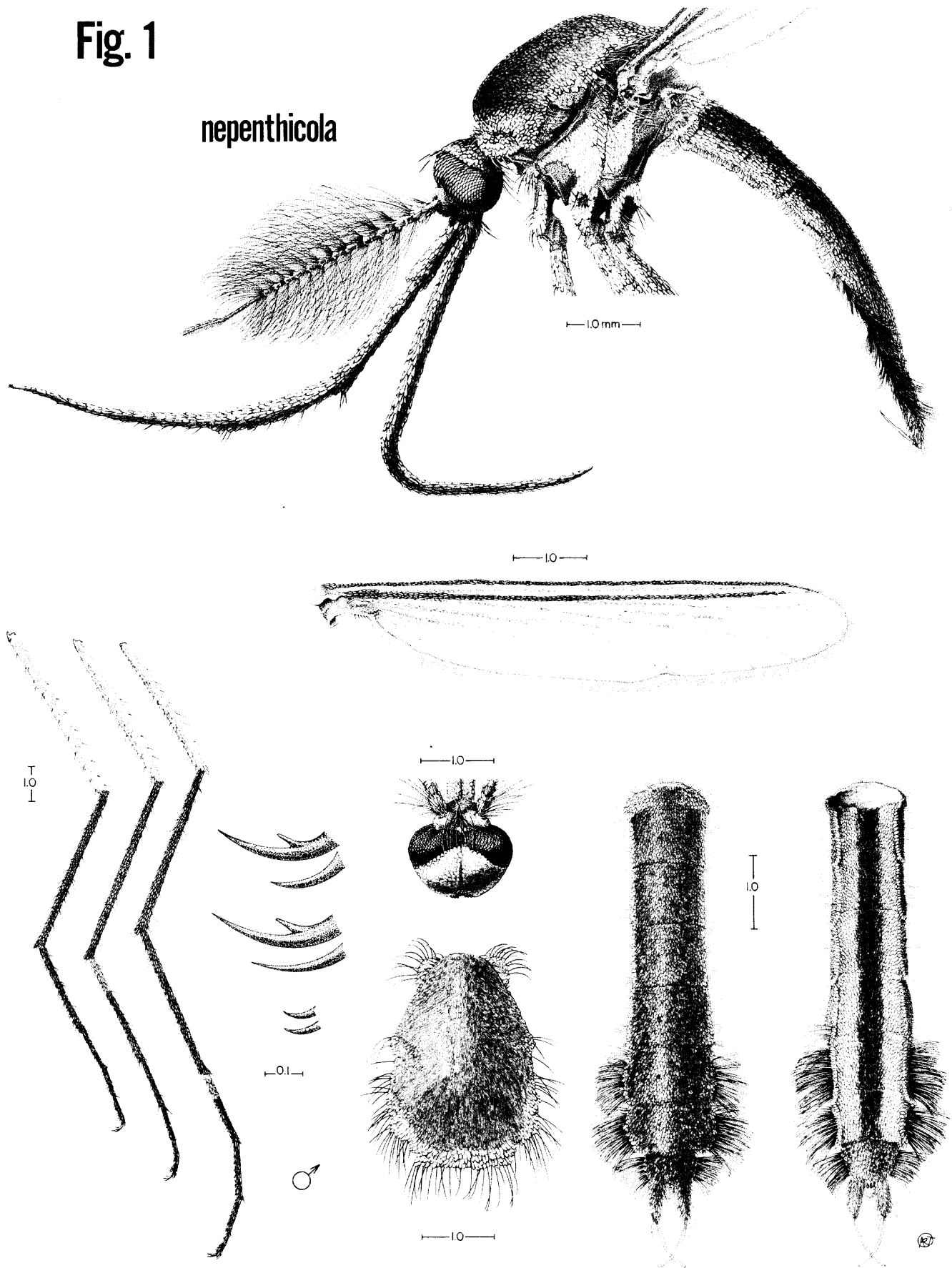
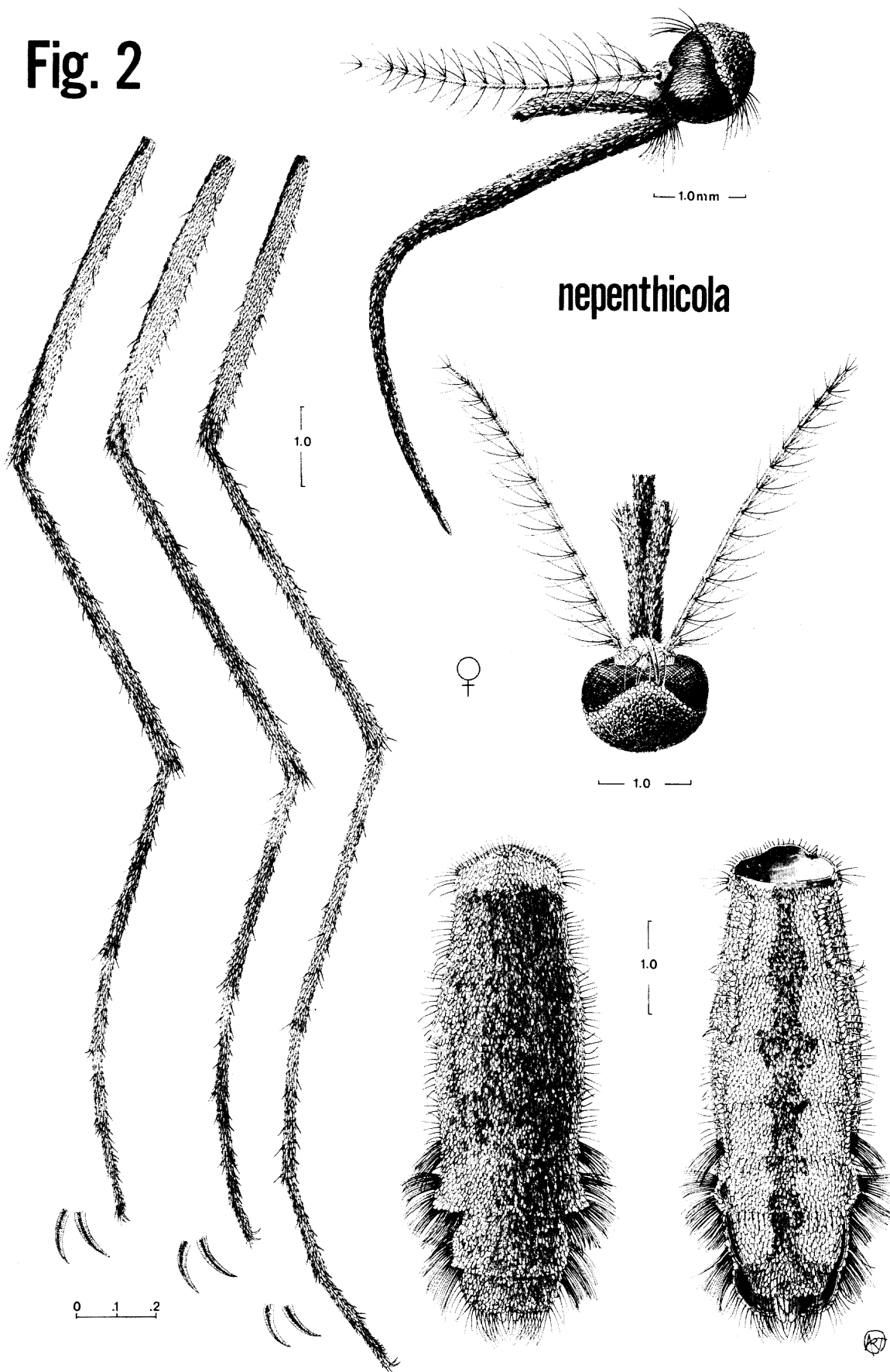
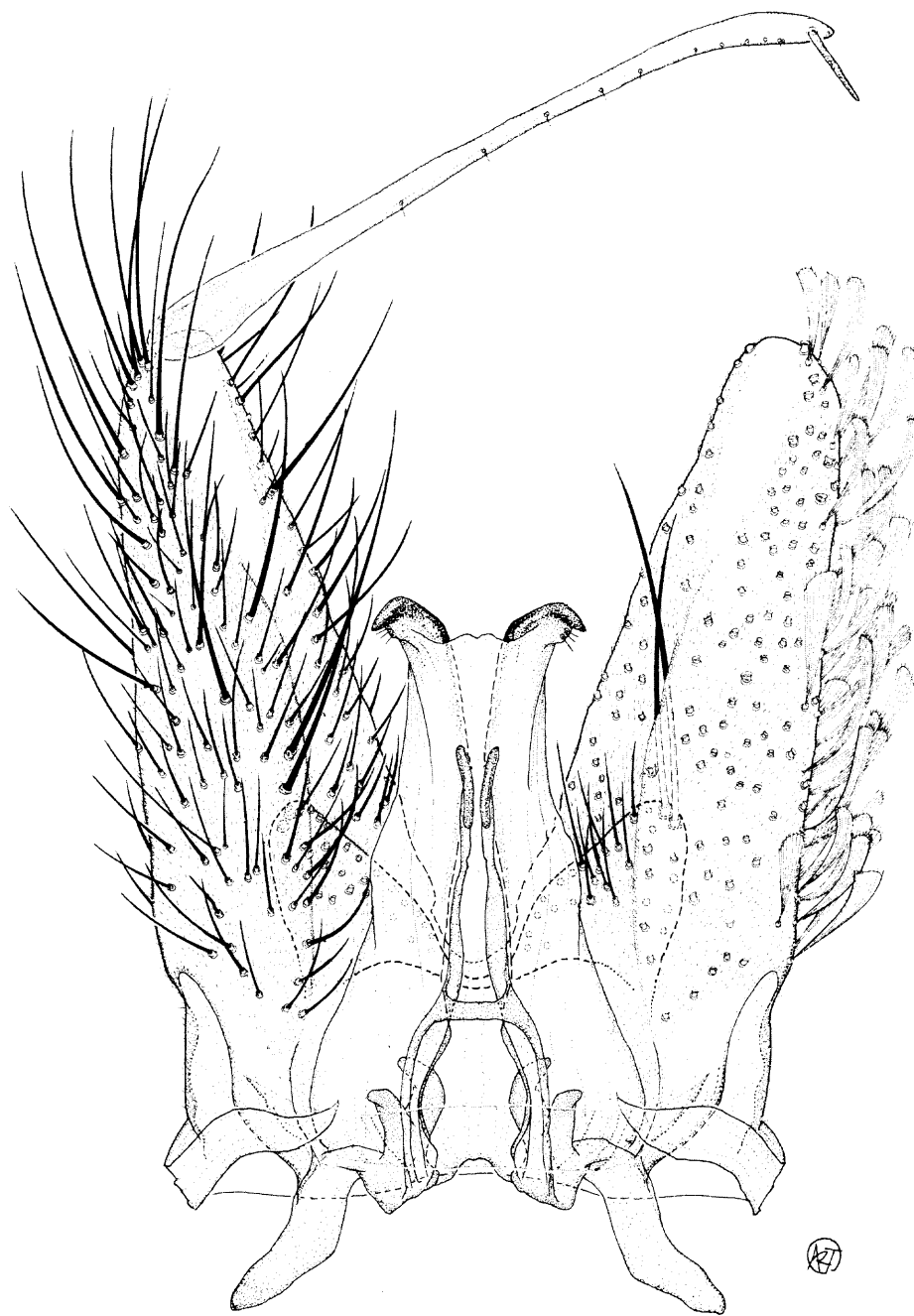


Fig. 2

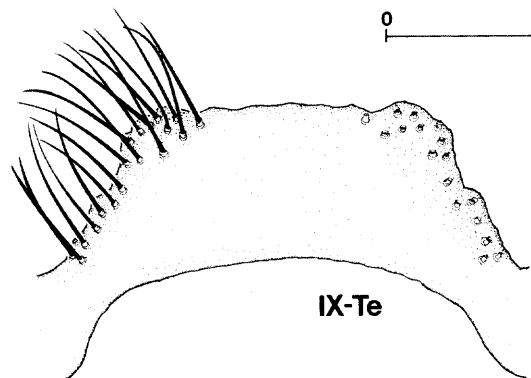


**Fig. 3**



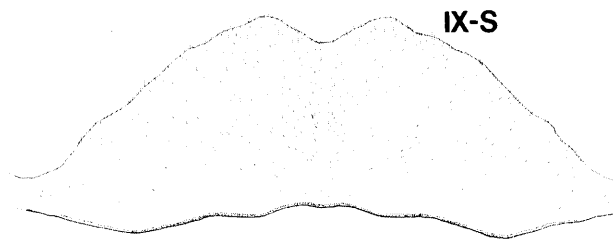
0 0.5mm

**nepenthicola**



**IX-Te**

— 0.1 —



**IX-S**

— 0.1 —

**Fig. 4**

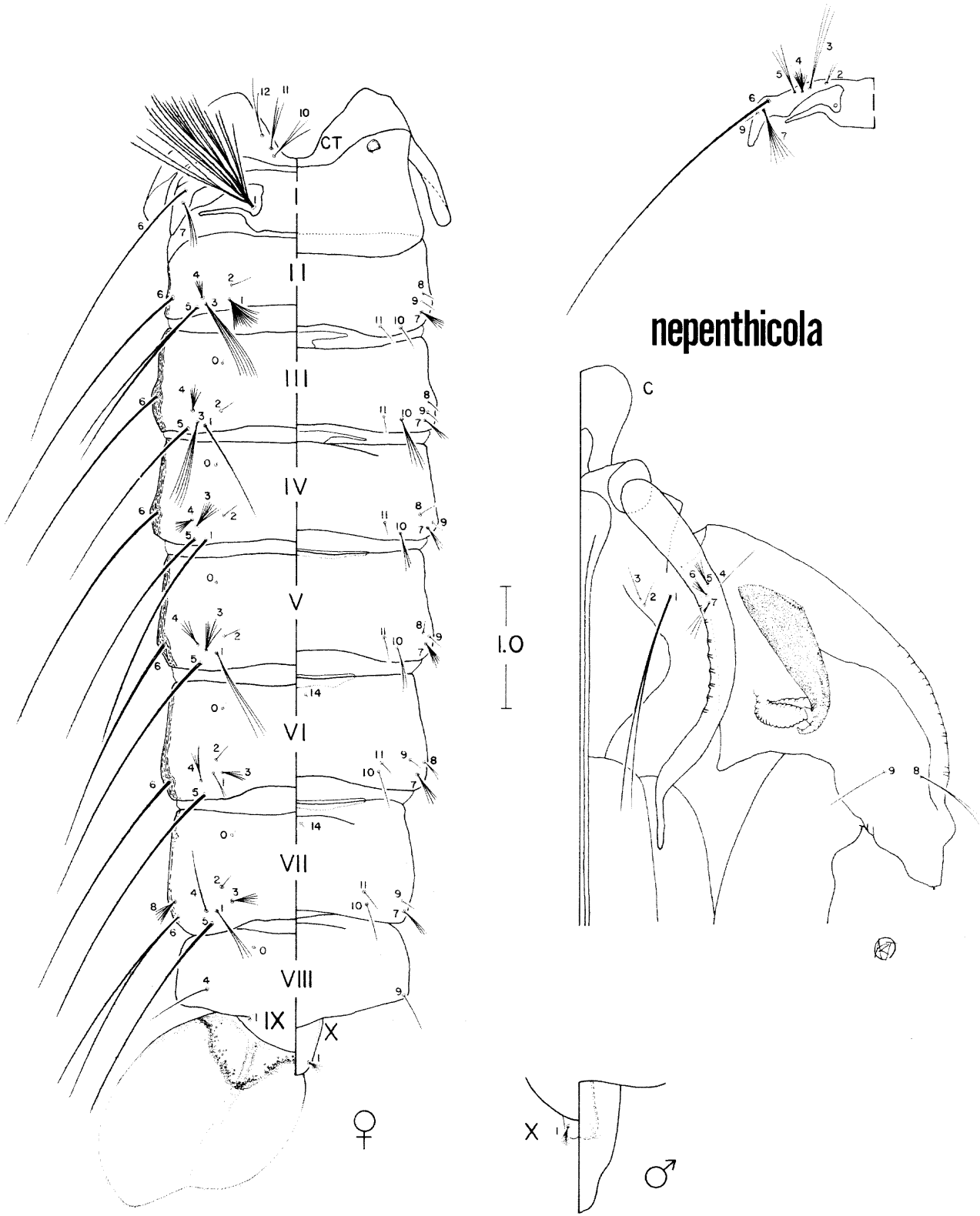


Fig. 5

