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**Hawaiian *Toxorhynchites* (Diptera : Culicidae)**

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## Hawaiian *Toxorhynchites* (Diptera : Culicidae)<sup>1</sup>

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Several species of *Toxorhynchites* have been introduced into Hawaii for biological control of *Aedes albopictus* (Skuse). Of these introductions, only 2, *T. brevipalpis* Theobald from South Africa and *T. amboinensis* (Doleschall) [misidentified as *T. splendens* (Wiedemann)] from the Philippines have been definitely established. *T. inornatus* (Walker), introduced by Pemberton in 1929, was released and larvae were found several miles from the release point; however, this species was presumed to have died out. Recently, Hardy (1967) reported that a female specimen collected on the windward side of Oahu was identified as *T. inornatus*. Additional collecting should be done to confirm this record since the females are rather difficult to identify. The 4th species, *T. theobaldi* (Dyar and Knab) (misidentified as *T. hypoptes* Knab) did not survive laboratory colonization and was not released (Hu, 1955). Hardy (1960) published the only taxonomic study of Hawaiian *Toxorhynchites* in which he treated *T. brevipalpis* and *T. splendens*. *T. splendens* was later correctly identified as *T. amboinensis* (Hardy, 1964). Nakagawa (1963) summarized the status of *Toxorhynchites* in Hawaii and gave a brief history of the introductions.

During the course of studies of mosquitoes of the Papuan region, I received a series of specimens of *T. amboinensis* Doleschall from the type locality, Amboina Island, Indonesia. Since the identity of the Philippine *amboinensis* has been questioned, I have compared the topotypic material with the *amboinensis* introduced into Hawaii. The results of this comparison are discussed elsewhere (Steffan, 1968). Since local mosquito workers have had difficulty in identifying the introduced *Toxorhynchites*, I am including keys to males, females, larvae and pupae of *T. brevipalpis*, *T. amboinensis* (Philippine species) and *T. inornatus*.

Terminology and general treatment of the taxa essentially follow Belkin (1962). Measurements were made with the Wild M5 stereomicroscope using a 10X measuring eyepiece. Measurements given include the mean and the range. The number of specimens measured is also given. The degree of white scaling on the tarsal joints was analyzed to determine the range of variation. The amount of white scaling on each joint is indicated by the percentage of the area covered by the white or pale scales measured from the anterodorsal or posterodorsal aspect. Meas-

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urements made of the ventral surface are not accurate since a narrow line of white scales frequently extends to the apex of the tarsal joints.

## KEYS TO HAWAIIAN TOXORHYNCHITES

## FEMALES

1. First fore tarsomere largely light scaled; scales of upper *ppn* white, bluish or greenish.....2  
First fore tarsomere largely or entirely dark scaled; scales of upper *ppn* bluish .....*brevipalpis*
2. Scales of upper *ppn* largely bluish or greenish.....*inornatus*  
Scales of upper *ppn* largely white.....*amboinensis*

## MALES

1. Caudal tuft of tergum VIII orange, scales of upper *ppn* largely bluish or greenish.....2  
Caudal tuft of tergum VIII black, scales of upper *ppn* largely white .....*amboinensis*
2. First flagellomere with mesal scales dark; lateral scale patches of sterna usually white.....*brevipalpis*  
First flagellomere with some mesal scales white; lateral scale patches of sterna usually yellow or golden.....*inornatus*

## KEY TO PUPAE

1. Hair 1-III single or double; 3-III single or double.....2  
Hair 1-III with 3 or more branches; 3-III 3-branched.....*inornatus*
2. Hair 1-II with 4 or less branches; 3-VI single; 6-VII single.....*brevipalpis*  
Hair 1-II with 6 or more branches; 3-VI with 3 or more branches; 6-VII usually with 2 or more branches.....*amboinensis*

## KEY TO LARVAE

1. Hair 2-II-VI usually attached to dorsal plate.....*ornatus*  
Hair 2-II-VI free from dorsal plate.....2
2. Hair 9-C with 2-4 branches; hair 12-C with 3-5 branches; hair 1-II, III always single.....*brevipalpis*  
Hair 9-C with 5 or more branches; hair 12-C with 6 or more branches; hair 1-II, III occasionally double.....*amboinensis*

**Toxorhynchites (Toxorhynchites) inornatus** (Walker, 1865) (Figs. 1-2)

♂:- Wing: 6.56 mm (range: 4.89-8.89 mm); fore femur: 4.40 mm (range: 3.44-5.78 mm); abdomen: 4.86 mm (range: 3.44-6.33 mm)—5 specimens measured. *Head*: vertex with greenish decumbent scales with indistinct narrow light orbital line becoming broader opposite *apn*; anten-

nal torus white tomentose, 1st flagellomere with dark scales dorsolaterally and pale scales mesally; palpus subequal to slightly longer than proboscis, segment 2 largely dark scaled except for preapical almost median pale band about 0.33 length of segment; segment 3 with apical pale band; proboscis dark scaled.

*Thorax:* integument dark; mesonotum with greenish scales becoming broader laterally and posteriorly, lateral scales bluish, scutellum with broad greenish scales; supraalar and scutellar bristles dark brown; *apn* with bluish-green scales dorsal  $2/3$ ds, pale ventral  $1/3$  or less; *ppn* with broad bluish-green scales, ventral margin of scale patch pale (below level of *sp*); scales of *ppl*, *stp*, *mep* and coxae white; *stp* with numerous scattered white bristles, *mep* with 1-2 lower bristles and a posterior row of pale bristles.

*Legs:* Largely dark scaled; fore femur and mid femur with pale scales along venter; mid tarsomere 1 with subbasal 0.24 white scaled (range: 0.15-0.31); mid tarsomere 2 pale scaled basal 0.43 (range: 0.33-0.50); hind femur with pale scales along venter, apex with a few pale scales; hind tarsomere 1 generally dark, occasionally with a trace of subbasal pale scales (range: 0.0-0.20); hind tarsomere 2 with subbasal 0.44 pale scaled (range: 0.36-0.48); tarsal claws: fore and mid legs unequal, larger with subbasal tooth; hindleg subequal, untoothed.

*Abdomen:* tergum I with greenish scales medially and with extensive white scales laterally; terga II-VIII with largely bluish scales, II-III occasionally greenish-blue, and with narrow longitudinal patches of pale scales generally not visible dorsally except for lateral patch of T-V which extends onto dorsal quarter of tergum; narrow white lateral scales extending to middle of segment VI; black caudal tuft beginning near middle of T-VI continuing along lateral and caudolateral edges of T-VII; orange along lateral margin of T-VIII; sterna dark scaled with extensive yellowish lateral scale patches; S-II, III yellowish lateral  $1/3$ rd; S-IV dark scaled; S-V-VI yellowish almost to middle with narrow median triangular dark patch; S-VII with triangular yellowish apicolateral patches.

♂ *genitalia* (Fig. 1):— As figured. *Segment IX:* tergum truncate apically with bristles arranged in 2 lateral groups of 12-16 bristles each. *Basimere:* bristles long, scales numerous laterally and ventrally; basal mesal lobe with numerous bristles and 2-3 longer, differentiated apical bristles. *Distimere:* subequal in length to basimere, slender, uniform in width except for slight basal swelling, with numerous short mesal hairs from basal  $1/4$ th to apex; spiniforms long. *Phallosome:* aedeagus narrow and moderately sclerotized apically, without denticles, dorsal submedian bridge indistinct posteriorly, but distinctly broader than that of *T. brevipalpis*.

♀:— Wing: 6.17 mm (range: 5.39-7.22 mm); forefemur: 4.65 mm (range: 4.17-5.00 mm); abdomen: 4.86 mm (range: 4.17-5.27 mm)—6 specimens measured. Similar to ♂ except: *Head:* antennal torus with broad decumbent translucent white scales dorsally and white tomentose

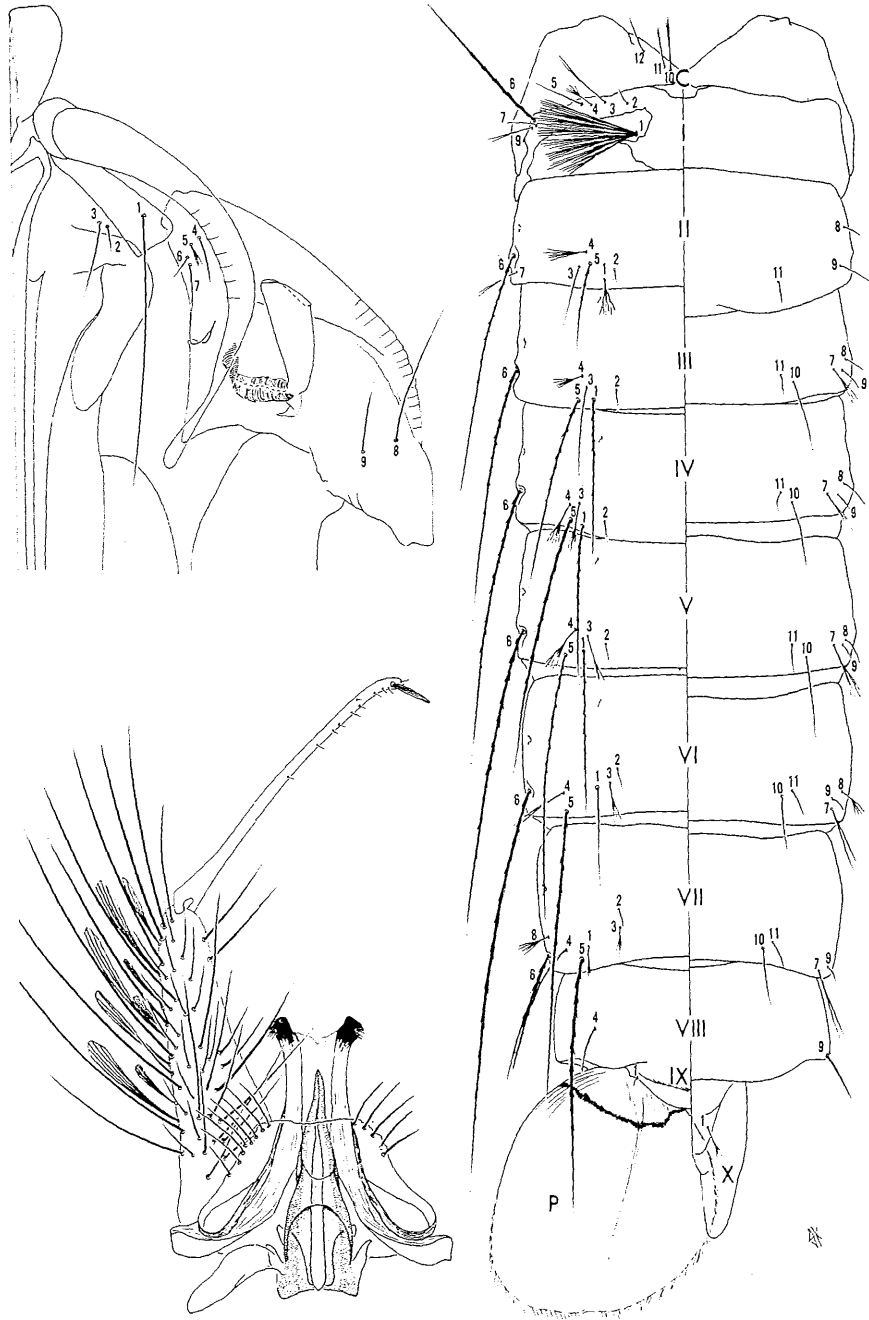


FIG. 1. *Toxorhynchites inornatus* (Walker), pupa and male genitalia

ventrally; flagellomere 1 with scattered translucent scales, somewhat shaded; palpus about 0.25 length of proboscis, largely bluish with indistinct pale patches at apices of terminal and second segments; 1st "segment" about 0.6 length of 2nd.

*Thorax:* fore femur with more extensive pale scaling; fore tarsomere 1 largely pale scaled except for narrow basal dark band (mean: 0.91, range: 0.88–0.94); fore tarsomere 2 white scaled basal 0.55 (range: 0.50–0.58), white scales frequently extend to apical 1/3rd ventrally; mid femur pale scaled ventrally and ventroposteriorly: mid tibia with white to yellowish scales except for narrow black apical and basal bands; mid tarsomere 1 white scaled about basal 0.54 (range: 0.41–0.61); mid tarsomere 2 usually entirely white scaled, occasionally apical 0.05 dark scaled; mid tarsomere 3 usually white scaled, occasionally shaded apically; mid tarsomere 4 usually white scaled, occasionally dark scaled apical 1/3rd; mid tarsomere 5 white or dark scaled; hind femur pale scaled ventrally and ventroposteriorly; hind tibia pale scaled median 1/3rd; hind tarsomere 1 with subbasal 0.36 pale scaled (range: 0.25–0.43); hind tarsomere 2 largely pale scaled except for about apical 1/4th (mean: 0.73, range: 0.61–0.90).

*Abdomen:* terga II–III with greenish-bronzish scales dorsally, T–IV–VIII with bluish scales; tergum V with broad dorsolateral pale scaled patch extending to median 1/3rd; lateral hairs white to caudal 1/4th of T–VI; black caudal tuft begins at posterior 1/4th of T–VI extending along lateral-caudolateral margin of T–VII and becoming whitish-yellowish on T–VIII; sternal lateral pale patches generally more distinct and extensive than those on ♂.

*LARVA* (Fig. 2). *Head:* hair 9-C with 2–3 branches; 12-C with 2–4 branches. *Thorax:* hair 1-P single, 2-P single or double; 6-P single, 10-P single, noticeably thicker than 12-P and barbed; 1-M about 1/2 length of 2-M; 7-M with 1–4 branches; 2-T single or double. *Abdomen:* hairs 2-I, II, III usually on dorsal plate, occasionally one may be free from plate but never all of them; 9-I with 1–3 branches; 10-I single or double; 12-II double; 1-III, IV usually single, rarely double; 3-III usually double, rarely single; 4-III usually single, occasionally double; 8-III with 1–3 branches; 12-III with 2–3 branches; 11-IV single or double; 4 and 10-V single or double; 12-V with 2–4 branches; 1-VI with 2–3 branches, simple; 5-VI single or double, simple or barbed. *Siphon:* index about 2.2–2.6. *Anal segment:* caudal marginal spicules generally alternately long and moderate, moderate spicules generally 1/2 to 1/3rd length of longer ones.

*PUPA* (Fig. 1). *Cephalothorax:* hair 6-C single or double; 7-C with 1–3 branches; 10-C and 12-C with 5 branches; 10-C subequal in length to 11-C. *Abdomen:* hair 4-I with 6–8 branches; 5-I with 1–4 branches; 1-II with 8–9 branches; 3-II with 1–3 branches; 1-III with 3–4 branches; 3-III with 3 branches; 7-III with 1–3 branches; 3-IV and 3-V with 4–5 branches; 3-VI with 2–4 branches; 1-VII single; 6-VII with 1–5 branches.

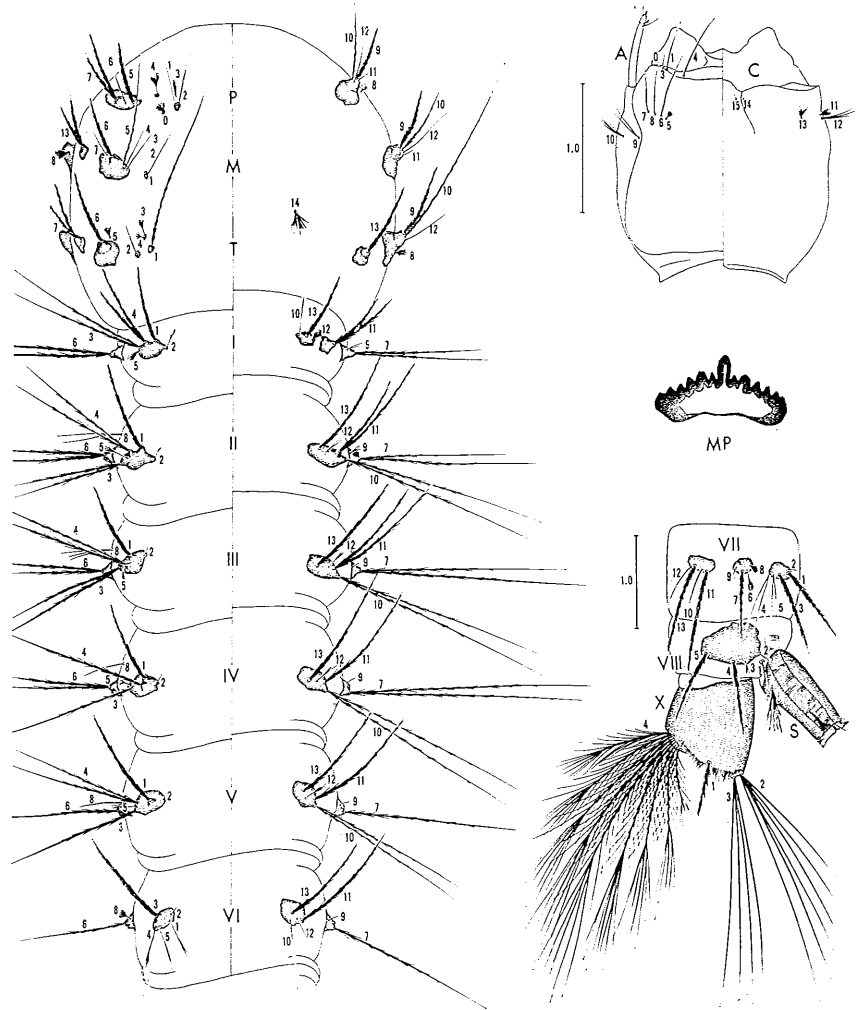


FIG. 2. *Toxorhynchites inornatus* (Walker), larva

Material examined: 16 specimens from original colony collected near Rabaul, New Britain, February and June, 1929, C. E. Pemberton; 5 ♂♂, 6 ♀♀, 3 larvae, 3 pupae, 3 ♂ genitalia slide preparations.

Distribution: New Guinea (typical form); New Britain, New Ireland (new record); Queensland, Australia, Fiji (introduced), and ? Hawaii (introduced).

Remarks: Although larvae were found several miles from the original release point, *T. inornatus* was believed to have died out (Hu, 1951 and Nakagawa, 1963). Hardy (1967) reported that a single female, taken

on the windward side of Oahu was identified as *T. inornatus*; however, since female *Toxorhynchites* are often difficult to identify, this record is questionable. Additional collecting on the windward side has failed to yield any more specimens of *inornatus*.

**Toxorhynchites (Toxorhynchites) brevipalpis** Theobald, 1901 (Figs. 3-4)

♂:— Wing: 7.23 mm (range: 6.09–8.22 mm); fore femur: 4.73 mm (range: 4.22–5.11 mm); abdomen: 6.20 mm (range: 5.44–7.00 mm)—15 specimens measured. *Head*: vertex with bluish or greenish decumbent scales with indistinct narrow light orbital line; antennal torus white tomentose; 1st flagellomere with dark scales dorsally and mesally; palpus subequal to or slightly longer than proboscis, bluish-purple, segment 2 with narrow patch of dorsolateral apical white scales and scattered white scales dorsally, segment 3 with small subbasal and larger preapical dorsolateral white scale patches; proboscis bluish-purple.

*Thorax*: integument black; mesonotum with small and somewhat narrow greenish to bronzish scales; lateral margins of mesonotum, *apn* and *ppn*, except for narrow ventral band of white scales on *apn* and *ppn*, with broader bluish and purplish scales; scutellum with small broad greenish or bronzish scales; supraalar and scutellar bristles yellowish orange; scales of *ppl*, *stp*, coxae white; *stp* with scattered long white setae; *mep* with 1 small anterior upper and 1-2 strong lower bristles and with several strong white posterior bristles.

*Legs*: largely bluish-purple except femora whitish ventrally and ventroposteriorly; fore tarsomere 1 usually dark, occasionally with scattered white subbasal scales; fore tarsomere 2 occasionally white scaled basal anterior half; mid tarsomere 1 with narrow basal white band usually less than 1/4th length of "joint" (range: 0.09–0.22); mid tarsomere 2 white scaled to about apical 1/3rd or 3/4ths (range: 0.42–0.59); hind tarsomere 1 occasionally with a few subbasal white scales (range: 0.0–0.8); hind tarsomere 2 white scaled basal 2/3rds (range: 0.40–0.66).

*Abdomen*: tergum I medially with bluish-greenish scales, laterally white; terga II–VIII dorsally, with bluish-purple scales, laterally with patch of white scales, generally not visible from above except for lateral white patch of tergum VI which extends slightly onto dorsum; tergum VI with caudolateral tuft nearly all white, occasionally a few long dark scales; tergum VII with caudolateral tuft all black, tergum VIII with orange caudolateral tuft; sterna largely with bluish-purple scales, sterna II–VII with lateral patches of white scales; II–III with white patches extending about 1/3rd width of sternum mesally, IV extending only about 1/5th, V–VI extending about 2/5ths and those of VII about 1/3rd.

♂ *genitalia* (Fig. 3):— As figured. *Segment IX*: tergum truncate apically with bristles arranged in 2 lateral groups of about 18 bristles each. *Sidepiece*: bristles long, scales numerous laterally and ventrally; basal

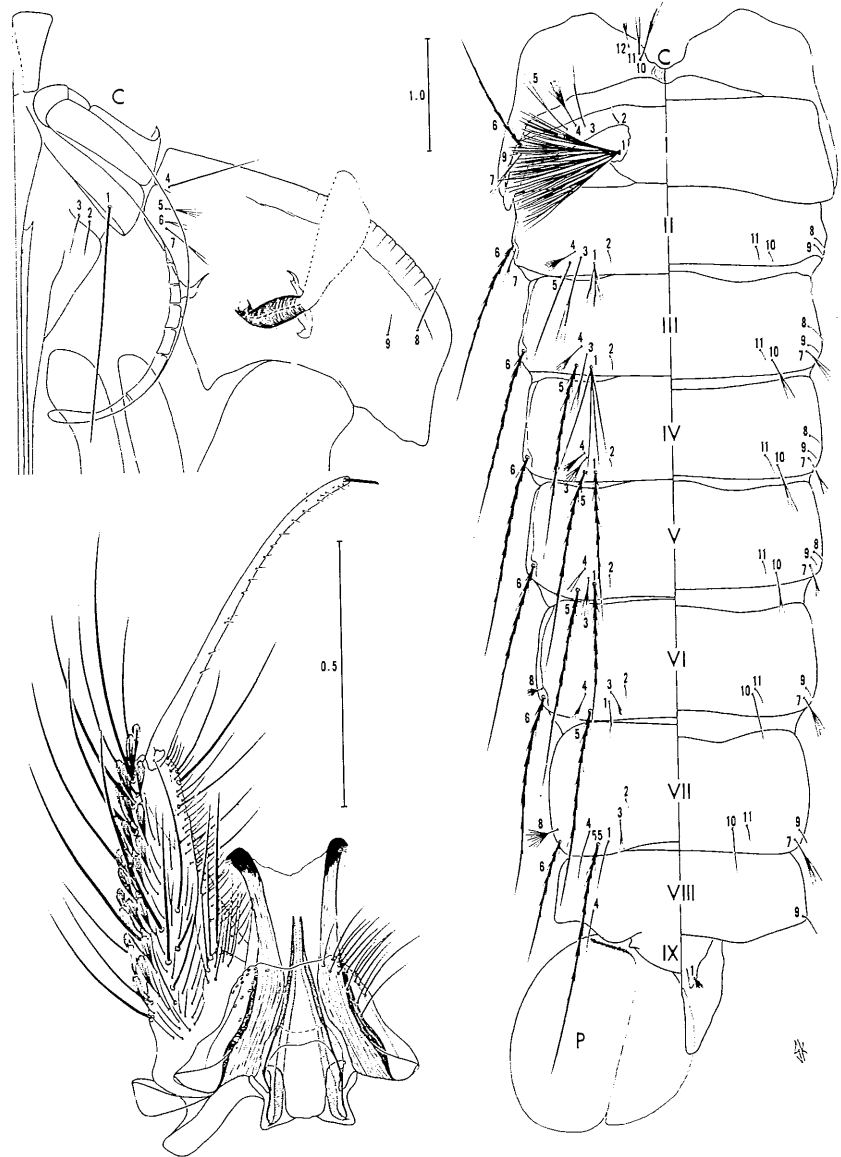


FIG. 3. *Toxorhynchites brevipalpis* Theobald, pupa and male genitalia

mesal lobe with numerous bristles and 2-3 longer differentiated apical bristles. *Clasper*: about 0.9X length of sidepiece; slender, uniform in width except for slight basal swelling with numerous short hairs beyond basal 0.2; spiniform long. *Phallosome*: aedeagus very narrow and strongly sclerotized apically, without denticles, also with conspicuous strongly sclero-

tized narrow dorsal submedian bridge.

♀ :-Wing: 5.90 mm (range: 5.33–6.66 mm); fore femur: 4.22 mm (range: 3.89–4.47 mm); abdomen: 4.68 mm (range: 4.35–5.43)—15 specimens measured. *Head*: similar to ♂ except: antennal torus with broad decumbent white scales dorsally and ventrally with white tomentose; scale patch of flagellomere 1 smaller and dark, palpus about 0.25 length of proboscis with bluish-purple scales, 1st "segment" about 0.7 length of 2nd.

*Thorax*: similar to ♂ except for tarsal patterns; fore tarsomere 2 white scaled except for apical 0.10 (range: 0.72–0.98); mid tarsomere 1 with basal white band extending about 0.21 length of joint (range: 0.13–0.35); mid tarsomere 2 white scaled to about apical 0.25 (range: 0.55–0.98); hind tarsomere 2 white scaled about basal 0.60 (range: 0.50–0.80).

*Abdomen*: similar to ♂ except lateral pale patch of tergum VI smaller; caudal tufts less conspicuous; sterna V–VI with broader lateral white patches occasionally meeting apically on V.

**LARVA** (Fig. 4). *Head*: hair 9-C, 2–4 branched; 12-C with 3–5 branches. *Thorax*: hair 1-P single; 2-P single or double; 6-P with 2–4 branches; 10-P single, noticeably thickened and barbed; 1-M about 1/2 length of 2-M; 7-M with 2–5 branches; 2-T single or double. *Abdomen*: hairs 2-I, II, III free from dorsal plate; 9-I double; 10-I single; 12-II with 2–3 branches; 1-III, IV single; 3-III single or double, 4-III single; 8-III single; 12-III with 1–3 branches; 11-IV single; 4 and 10-V single; 12-V with 1–4 branches; 1-IV single or double and simple; 5-VI with 1–4 branches, simple or barbed. *Siphon*: index about 2.1–2.4. *Anal segment*: caudal marginal spicules generally alternately long and short at ventral and dorsal third, short spicules less than 1/3rd length of longer ones.

**PUPA** (Fig. 3). *Cephalothorax*: hair 6-C double; 7-C single; 10-C with 5–9 branches; 12-C single or double; 10-C about 1/2 length of 11-C. *Abdomen*: hair 4-I with 3–6 branches, 5-I with 4–6 branches; 1-II with 2–4 branches, 3-II single; 1-III, 3-III and 7-III single or double; 3-IV with 2–4 branches; 3-V double, 3-VI single; 1-VII single or double; 6-VII single.

**Material examined**: 70 specimens reared at the Board of Health Laboratory, Honolulu, 1952; 43 ♂♂, 21 ♀♀, 3 larvae, 3 pupae, 3 ♂ genitalia slide preparations.

**Distribution**: Ethiopian region, Madagascar, Hawaii (introduced) and Samoa (introduced).

**Remarks**: *T. brevipalpis* was first brought into Hawaii in August 1950 from Johannesburg, South Africa. Between 1950 and 1957, this species was released on all the major islands (Nakagawa, 1963). It is apparently well established on Oahu; however, I have surveyed areas where both *T. brevipalpis* and *T. amboinensis* were reportedly established and so far have found only *amboinensis*. These two species can be easily separated by the characters listed in the keys. The eggs of the two species can be distinguish-

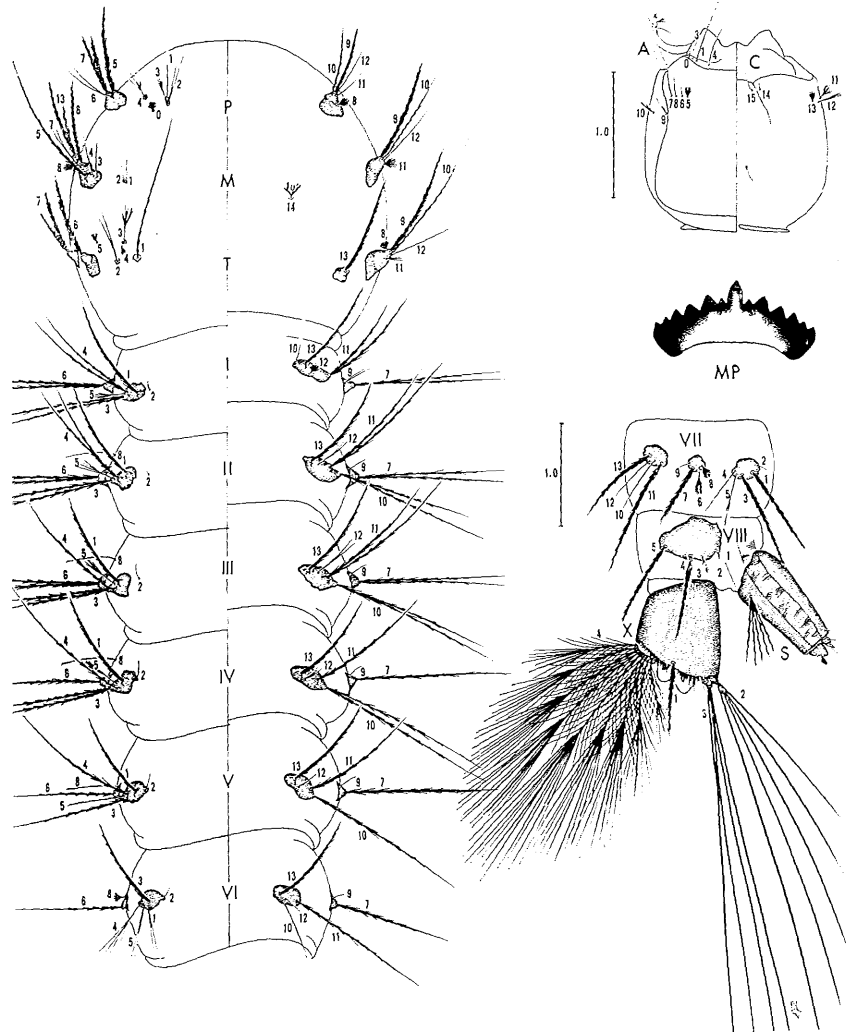


FIG. 4. *Toxorhynchites brevipalpis* Theobald, larva

ed by the way they float on the water—those of *T. brevipalpis* float just below the surface, while those of *T. amboinensis* float on the surface.

**Toxorhynchites (Toxorhynchites) amboinensis** (Doleschall, 1857)  
(Figs. 5–6)

♂:—Wing: 6.45 mm (range: 4.89–8.44 mm); fore femur: 4.33 mm (range: 3.11–5.11 mm); abdomen: 5.52 mm (range: 4.40–7.22 mm)—20 specimens measured. *Head*: vertex with bluish or greenish broad decumbent scales with indistinct narrow light orbital line becoming broader

opposite *apn*; antennal torus white tomentose; 1st flagellomere with dark scales dorsally and scattered white or translucent scales mesally; palpus subequal to or slightly longer than proboscis, largely bluish-purple; segment 2 with narrow patch of dorsolateral apical white scales and with scattered white scales dorsally, segment 3 with small subbasal dorsal white patch and larger subapical dorsolateral white patch; proboscis dark scaled.

*Thorax*: integument dark, mesonotum with small broad greenish to bronzy scales becoming bluish along edges; scutellum with small broad decumbent bluish and greenish scales; supraalar and scutellar bristles dark; *apn* largely with bluish scales, ventral border pale; *ppn* largely white scaled from middle of *sp* ventrad; scales of *ppl*, *stp*, *mep* and coxae white; *stp* with numerous scattered long white setae; *mep* with 1-2 strong lower bristles and a row of numerous pale posterior bristles.

*Legs*: largely bluish-purple; fore leg with scattered pale scales on venter of fore femur; mid leg with scattered paler scales on venter of femur; mid tarsomere 1 with basal 0.28 pale scaled (range: 0.12-0.41); mid tarsomere 2 with basal 0.40 pale scaled (range: 0.10-0.68); hind leg with pale scales on ventral and posterior surfaces, posteriorly basal 1/2 pale scaled; hind tarsomere 1 with a trace of pale subbasal scales (range: 0.00-0.80), tarsomere 2 with basal 0.45 pale scaled (range: 0.36-0.60); *tarsal claws*: fore and mid legs unequal, larger with subbasal tooth; hind leg subequal, untoothed.

*Abdomen*: tergum I with bluish or greenish scales, lateral tergum white scaled; terga II-VII bluish-purple with narrow longitudinal patch of pale scales generally not visible from above except on tergum V where white patch occasionally extends onto dorsum; white lateral hairs extending to middle of segment VI, black caudal tuft beginning at middle of VI continuing along lateral and caudolateral edges of VII and VIII; sterna largely with bluish-purple scales, pale (white or slightly yellowish) scaled lateral patches occupying about lateral 1/4th of sterna II, III, lateral 1/5th of sternum IV, lateral third of sterna V, VI, extent of pale scaling is variable on most sterna—the above represents the optimum.

♂ *genitalia* (Fig. 5):— As figured. *Segment IX*: tergum truncate apically with bristles arranged in 2 lateral groups of about 5-21 bristles each. *Basimere*: bristles long, scales numerous laterally and ventrally; basal mesal lobe with numerous bristles and 2-3 longer, differentiated apical bristles. *Distimere*: subequal in length to basimere, slender, uniform in width except for slight basal swelling, with numerous short mesal hairs along distal half; spiniform long. *Phallosome*: aedeagus narrow and moderately sclerotized apically, without denticles, dorsal submedian bridge broad, only anterior margin distinct.

♀:— Wing: 5.10 mm (range: 4.33-7.22 mm); fore femur: 3.74 mm (range: 3.11-5.22); abdomen: 4.22 mm (range: 3.56-6.00 mm)—20 specimens measured. Similar to ♂ except: *Head*: antennal torus with

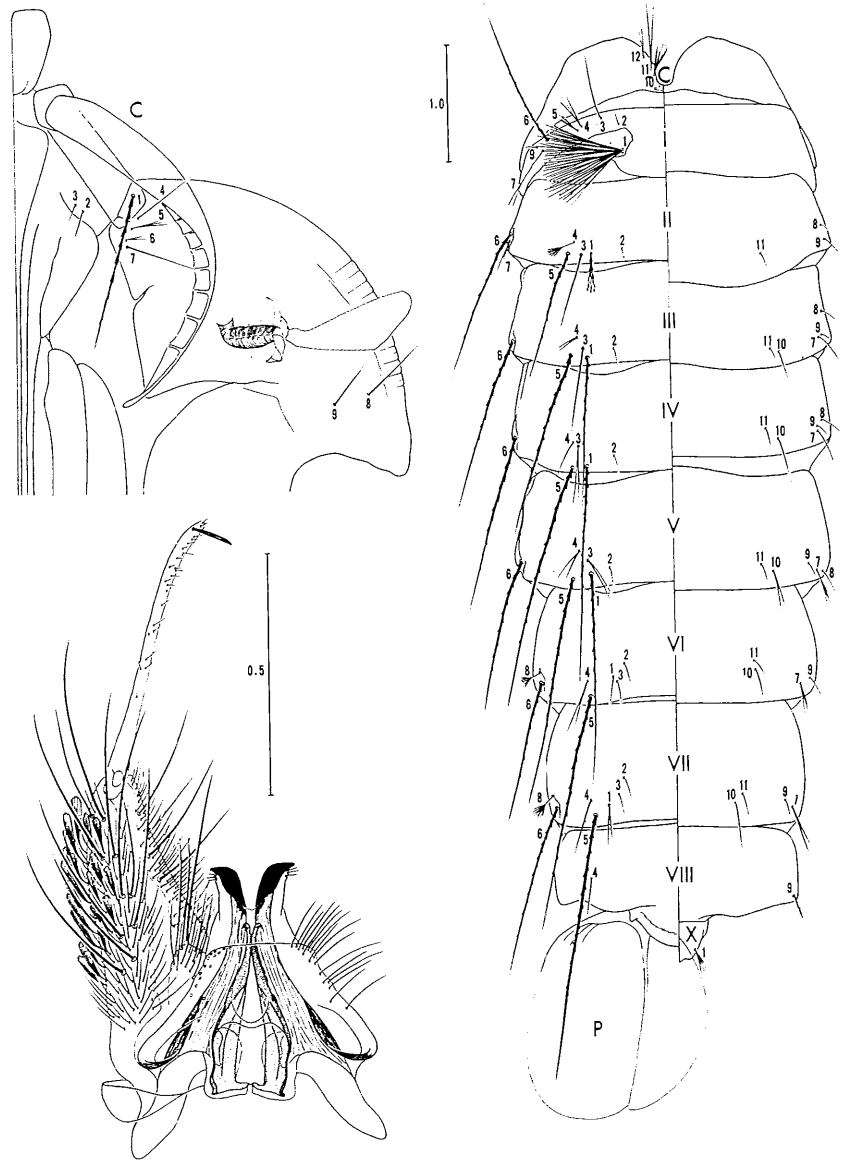


FIG. 5. *Toxorhynchites amboinensis* (Doleschall), pupa and male genitalia

broad decumbent white scales dorsally and ventrally white tomentose; 1st flagellomere with dark dorsal scales and scattered pale mesal scales; palpus about 0.25 length of proboscis, with bluish-purple scales, first "segment" about 0.7 length of second.

*Thorax*: fore femur and tibia with ventral pale or golden scales; fore

tarsomere 1 largely white scaled except for narrow black basal band (0.07–0.27 length of joint), fore tarsomere 2 with basal 0.45 white scaled (range: 0.10–0.74); mid femur with ventral and tibia largely pale or golden scaled except for tibial apex; mid tarsomere 1 with basal 0.54 white scaled (range: 0.46–0.61), ventrally frequently pale scaled to apex; mid tarsomeres 2, 3 and 4, generally white scaled, occasionally 3 and 4 dark scaled ventrally; mid tarsomere 5 pale scaled, but frequently dark scaled; hind femur pale scaled ventrally and anterior and posterior basal half; hind tibia with scattered pale scales ventrally; hind tarsomere 1 with subbasal 0.18 pale to

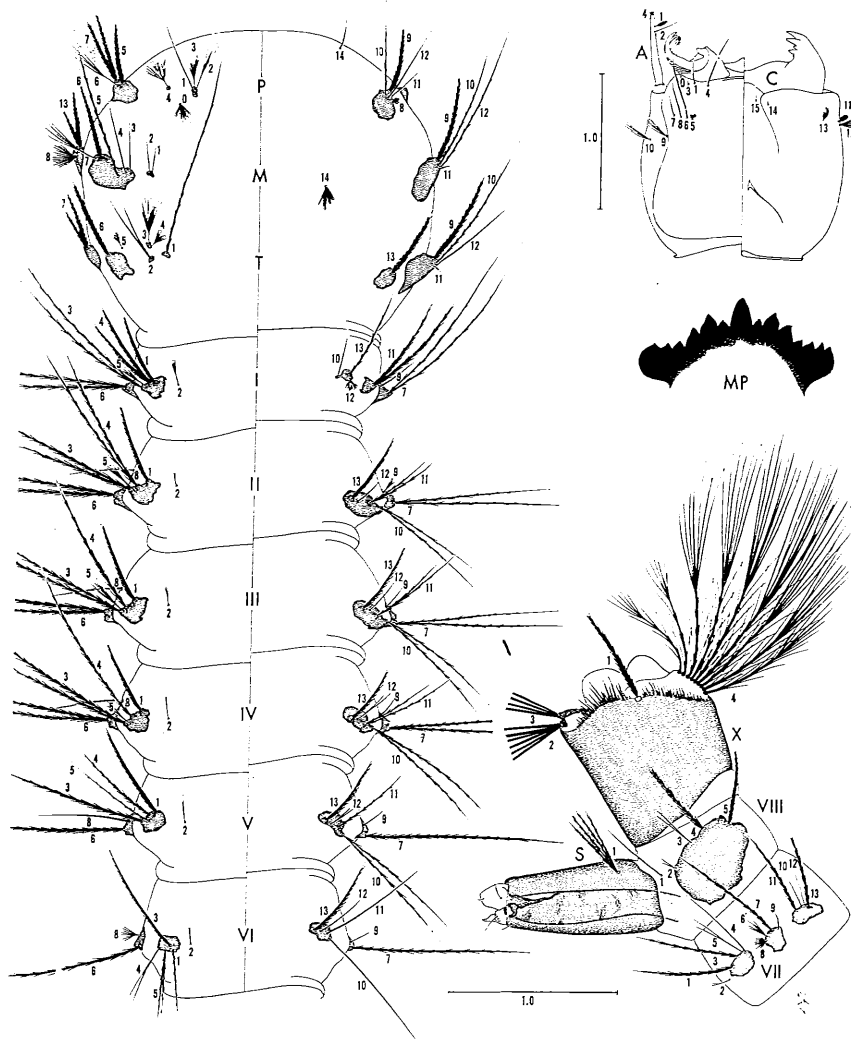


FIG. 6. *Toxorhynchites amboinensis* (Doleschall), larva

golden scaled (range: 0.12–0.27); hind tarsomere 2 with basal 0.71 pale scaled (range: 0.62–0.82).

*Abdomen*: lateral tergal white patches frequently visible dorsally on II, III and V; black caudal tuft beginning at posterior 1/3rd of tergum VI and continuing through VII; tergum VIII with orange caudal tuft; sternal lateral pale patches generally more distinct especially on sterna II, III, V and VI.

LARVA (Fig. 6). *Head*: hair 9–C with 5–6 branches; 12–C with 4–8 branches. *Thorax*: hair 1–P single, 2–P with 2–4 branches, 6–P with 4–6 branches; 10–P single or rarely double, noticeably thicker than 12–P and with fine barbs; 1–M subequal to or 2/3rds length of 2–M; 7–M with 2–6 branches; 2–T with 1–3 branches. *Abdomen*: hairs 2–I, II, III free from dorsal plate; 9–I single or double; 10–I single; 12–II single or double; 1–III, IV single or double; 3–III double; 4–III single 8–III single; 12–III single or double; 11–IV double; 4–V single or double, rarely with 4 branches; 10–V double; 12–V with 1–3 branches; 1–VI with 1–4 branches, generally bare, occasionally weakly barbed; 5–VI single or double, usually weakly barbed. *Siphon*: index about 1.5–2.3. *Anal segment*: caudal marginal spicules generally irregularly long and moderate at ventral and dorsal 1/3rd; moderate bristles at least 1/3rd or 1/2 length of longer ones.

PUPA (Fig. 5). *Cephalothorax*: hair 6–C usually single or double, occasionally with up to 5 branches; 7–C single, 10–C usually with 2–4 branches, occasionally with up to 10 branches; 10–C subequal to or about 2/3rds length of 11–C; 12–C with 1–3 branches. *Abdomen*: hair 4–I with 3–6 branches; 5–I with 1–3 branches; 1–II with 6–18 branches, 3–II single; 1–III and 3–III single, occasionally apical 1/3rd or less split; 7–III with 1–4 branches; 3–IV with 3–6 branches; 3–V with 2–4 branches; 3–VI with 3–6 branches; 1–VII with 2–6 branches; 6–VII generally with 2–5 branches, rarely single.

Material examined: 155 specimens from Oahu, 59 ♂♂, 56 ♀♀ 20 larvae, 20 pupae, 10 ♂♂ genitalia slide preparations, 10 individual rearings.

Distribution: Amboina Island, Indonesia; Moluccas, Philippines, Thailand and Hawaii (introduced).

Remarks: This species was introduced as *T. splendens* in December 1953 from the Philippines. Belkin, in a letter to Miss M. D. Delfinado (Hardy, 1964), correctly identified it as *T. amboinensis*, but questioned whether it was the true *amboinensis*. I have studied a series of specimens of *amboinensis* from the type locality Amboina Island and find they are very similar. There are some differences, as noted elsewhere (Steffan, 1968), but not great enough to justify separation as distinct taxa.

#### ACKNOWLEDGEMENTS

I wish to thank Dr. Alan Stone for providing notes on the types of *Megarhinus lewaldi* Ludlow and *T. amboinensis* (Doleschall). I also wish to

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