

Anopheles (Anopheles) peytoni new species, the
 "An. insulaeflorum" auct. from Sri Lanka
 (Diptera: Culicidae)

Varuni L. Kulasekera¹, Bruce A. Harrison²
 and F. Prashantha Amerasinghe¹

ABSTRACT. The adults, male genitalia, pupa and larva are described for *Anopheles (Ano.) peytoni*, a new species from Sri Lanka. The new species is compared with and differentiated from the most closely related species in the Aitkenii Group, and from *An. aitkenii*, the other species of the Group recognized from Sri Lanka. The distribution and bionomics of *peytoni* are discussed, including its man-biting behavior.

INTRODUCTION. *Anopheles insulaeflorum* (Swellengrebel and Swellengrebel-de Graaf, 1920), has been recorded from Sri Lanka since Carter (1925) listed this species and illustrated larval differences to separate it from *An. aitkenii* James, 1903. Numerous other authors (e.g., Puri 1930, Christophers 1933, Chow et al. 1954, Stone et al. 1959, Reid 1965, 1968; Jayasekera and Chelliah 1981, Ramachandra Rao 1984) have continued to list *insulaeflorum* from Sri Lanka, yet not one of those authors professed to seeing specimens from Sri Lanka.

Anopheles insulaeflorum has been recorded from many areas of the Oriental faunal region and in Reid (1965, 1968) it was listed as distributed from India and Ceylon (=Sri Lanka) in the west, Formosa (=Taiwan) and the Philippines in the east and through Malaya and Indonesia in the south. However, this distribution was altered significantly when Harrison and Scanlon (1974) described a new species, *pilinotum*, for the *insulaeflorum* specimens previously recorded from the Philippines and eastern Indonesia. Further, Harrison and Scanlon (1975) redefined *insulaeflorum* and its distribution. This redefinition included comments regarding the validity of Carter's (1925) record of *insulaeflorum* from Sri Lanka. Harrison and Scanlon (1975: 169) stated, "Carter. (1925) recorded *insulaeflorum* from Sri Lanka and illustrated the inner clypeal differences between *aitkenii* and *insulaeflorum*. Based on these illustrations we are convinced that his "insulaeflorum" larva (p. 80, fig. 5d) is not *insulaeflorum* because the bases of setae 2-C are nearly as wide apart as 2-C and 3-C on one side. Since we have not seen specimens of *insulaeflorum* from Sri Lanka and can find no substantial evidence it occurs there, we consider previous records of this species from Sri Lanka as doubtful."

Since 1975, several mosquito collections have been made in Sri Lanka through the auspices of the Smithsonian Institution's "Biosystematic Studies of the Insects of Ceylon" project and the University of Peradeniya. These collections have produced

¹ Department of Zoology, University of Peradeniya, Peradeniya, Sri Lanka.

² Walter Reed Biosystematics Unit, Museum Support Center, Smithsonian Institution, Washington, DC 20560.

numerous specimens from several different areas which initially looked nearly identical to *insulaeflorum* in the larval stage, but upon closer examination were distinct. Separate and independent studies of the adult, pupal and larval stages of this species and the other Aitkenii Group species in Sri Lanka (*aitkenii* James) suggest that this is probably the species previously identified as *insulaeflorum* in Sri Lanka. Furthermore, this is an undescribed species belonging to the Aitkenii Group of *Anopheles* (*Anopheles*), which is clearly distinct from *insulaeflorum* and other Aitkenii Group species by adult, male genitalia, pupal and larval characters. Accordingly, we have collaborated to describe and name this new species below.

The terminology used follows Harbach and Knight (1980, 1982). An asterisk after a given life stage indicates an illustration. Collections were heavily biased for immature habitats so that adults which are often unidentifiable in the Aitkenii Group, could be reared with associated immature exuviae and precisely identified.

Anopheles (*Anopheles*) *peytoni* new species
(Figures 1,2)

Anopheles (*Anopheles*) *insulaeflorum* of Carter 1925: 67 (tax., distr., questionable identification of larva illustrated on p. 80); Puri 1930: 954 (tax., distr.); Christophers 1933: 111 (♂* ?, tax., distr.); D'Abrera 1944: 341 (distr., biol.); Puri 1948: 82 (distr.); Carter 1950: 87 (distr.); Chow et al. 1954: 116 (distr.); Stone et al. 1959: 20 (distr.); Reid 1965: 119 (distr.); Reid 1968: 248 (distr.); Harrison and Scanlon 1975: 167 (tax., records of *insulaeflorum* from Sri Lanka considered doubtful); Knight and Stone 1977: 21 (distr.); Jayasekera and Chelliah 1981: 4 (distr.); Ramachandra Rao 1984: 283 (tax., distr., biol.).

FEMALE. Unicolorous brown. **Head.** Vertex with narrow erect scales slightly expanded and notched at tip; interocular space narrow with short white scales and 4 long frontal setae; clypeus without scales; antennal pedicel and flagellomeres without scales; antennal whorl setae 3-5 times as long as segments; proboscis long and slender with dark decumbent scales; ratio forefemur/proboscis (sample of 10 females) range 1.00-1.11, mean 1.06; palpus slender, equal or slightly shorter than proboscis, 2 apical segments slightly swollen, with dark decumbent scales. **Thorax.** Anterior promontory without scales, with long dark brown setae; scutal integument tan, with paler orange dorsocentral lines and dark achrostichal line; scutum without scales, with long and short brown setae in anterior promontory, achrostichal, dorsocentral, lateral prescutal, scutal fossal, antealar and supraalar areas; prescutellar space bare; scutellum with long and short dark brown setae, without scales; antepnotum with long sparsely scattered setae; pleural area pale tan; pleural setae: 1 upper proepisternal, 1-3 prespiracular, 0,1 prealar, 1,2 upper and 1-3 lower mesokatepisternal, 1-4 upper and 0 lower mesepimeral. **Wing.** Unicolorous with narrow dark scales; no scales on humeral crossvein; cell M_2 /stem ratio 0.50-1.92 (mean 1.01); cell R_2 /stem ratio 1.5-3.5. Halter with dark scales on capitellum. **Legs.** Coxae without scales; upper midcoxa with 2,3 setae, femora, tibiae and tarsomeres long, slender and entirely dark scaled. **Abdomen.** Mottled gray brown with setae, no scales.

MALE. Habitus similar to female except antenna strongly plumose, palpus with 2 apical segments flattened and club-like. **Genitalia.** Gonocoxite without scales, with 2 parabasal setae on tubercle; internal seta inserted mesally on distal 0.25 of gonocoxite; claspette with 2 lobes, dorsal lobe with 2,3 outer dorsal setae, inner club formed from 1,2 separate basal stems (usually 2); outer dorsal setae same length or slightly shorter than club; ventral lobe with 3 large and 1 small setae and numerous minute spicules, setae on ventral lobe shorter than inner dorsal club; aedeagus abruptly narrows near apex and forms distinct ventrally bent hood; lateral spines present on aedeagus and when viewed from apical aspect 1,2 small spicules can be seen.

PUPA. (Fig. 1, Table 1). Unicolorous tan to light brown. **Cephalothorax.** Trumpet simple with deep meatal cleft; meatus/meatal cleft 0.23-0.36, mean 0.29; meatus length/trumpet length 0.18-0.26, mean 0.22; Setae 1-2-CT with 3-5 branches; 3-CT with 4-6 branches; 6-CT with 3,4 branches; 7-CT with 3-6 branches; both long but 6-CT slightly shorter than 7-CT; 8-CT single to trifid; 10-C long, stout, single to 4 branches distally; 12-CT with 3-5 branches. **Abdomen.** Seta 0 on segment III-VII simple to trifid; 0 on segments II and VIII always simple; seta 1 on III-VII well developed; 1-III with 5-13 branches, 1-IV with 5-9 branches; 1-V with 3-6 branches and 1-VI-VII with 3-5 branches; 5-I well developed with 2-5 branches, much longer than 2-I and 3-I; 5-V-VII strongly developed with stout central stem and many decumbent branches, as long as following segments; 5-V with 7-10 branches, 5-VI with 7-9 branches, 5-VII with 9-13 branches; 6-I with 3-5 branches, 1.5-2.0 times as long as segment; 6-II with 3-6 branches; 6-III with 1-3 branches, 0.5-0.9 length of segment; 7-I with 3-9 branches, as long as segment; 7-VI 0.35-0.90 as long as following segment; 7-VII 0.75-1.2 as long as following segment; 9-I-VII always simple; 9 IV-VII moderately long, without long tapering tip, but sharp pointed and dark brown; 9-IV 2.0-4.5 times length of 9-III; 9-V-VII 0.2-0.3 length of following segment; 10-IV-V 0.46-0.80 length of following segment. Paddle index 0.48-0.61, mean 0.57, refractile margin/paddle length 0.41-0.52, mean 0.46; fringe long, ratio fringe/1-P length 0.68-0.95(mean 0.80); outer margin evenly convex on distal half; 1-P long, simple, stout and pigmented, curved near tip; 2-P with 2-5 branches.

LARVA. (Fig. 2, Table 2). Unicolorous tan to dark brown. **Head.** Seta 2-C long, stout and simple, inserted close together, distance between the bases of 2-C 0.5 distance between bases of 2-C and 3-C on one side; 3-C simple or bifid (18 of 91 specimens bifid), 0.33 length of 2-C; 4-C with 4-6 branches, wider apart than 3-C; 5-7-C long and plumose, 5-C extending forward beyond bases of 2-C and 3-C; 8-C with 3-6 branches; 9-C with 5-9 branches; 10-C with 2-5 branches; 11-C with many branches, equal to length of antenna; 12-C with 3-5 branches; 13-C with 8-13 branches. **Antenna.** Base of antenna wider than tip; 1-A with 6-13 branches inserted on basal 0.20 of antenna; 4-A with 7-10 branches; 2-6-A attached at apex of antennal shaft. **Thorax.** 1-P with 8-11 branches, approximately 0.5 length of 2-P; 2-P with 9-16 branches arising from a sclerotized tubercle; 3-P single, fusiform, shorter than 1-P, closer to 2-P than 1-P is to 2-P; 4-P longer than 2-P, with many branches; 11-P short and simple, rarely branched, not fusiform; prothoracic pleural tubercle with short stout spine; 13-P with 4-9 branches; 14-P with 3-7 branches; 9 and 10 on all thoracic segments long and simple; 12-P, 12-M simple; 4-M with 3-5 branches, 13-M with 3-6 branches inserted between 8-M and mesothoracic pleural tubercle; 3-T with unpigmented leaflets, no filaments; 12-T with 2-4 branches; 13-T with 3-5 branches.

Abdomen. Seta 0-II-VII with 1-3 branches, on segment VIII with 1-4 branches; 1-I filamentous and branched; 1-II-VII with pigmented flattened leaflets with filaments; 2-VI with 4-7 branches; 3-I with 2-4 branches; 5-II with 8-12 branches; 6-III with 6-12 branches; 6-IV with 3-5 branches; 6-V with 4-6 branches, 6-IV, V 0.67 length of 6-III; 6-VI with 4-8 branches, 0.33 length of 6-III; 11-II with 2-4 branches; anterior median process on anterior spiracular lobe of spiracular apparatus unpigmented; pecten plate with 10-15 spines; 1-X with 2-4 branches, as long as saddle.

EGG. Unknown.

TYPE DATA. The holotype male of *An. peytoni* has its associated larval and pupal exuviae and male genitalia mounted on slides with the following collection data; "Sri Lanka, Coll. 214-2, Galle Dist., Kanneliya nr bungalow, 9 July 1975, Peyton & Huang". The holotype and its genitalia slide also bear a label reading "WRBU Prep. No. 86/245".

The allotype female, SL-502-18 with associated larval and pupal exuviae has the following collection data; "Sri Lanka, Coll. SL-502-18, Ratnapura Dist., Sinharaja Forest, 4 May 1986, V.L. Kulasekera".

An additional 15 females and 10 males with associated larval and/or pupal exuviae and 15 whole larvae from collections 189, 205, 209, 213, 214, 237, 238, 239, 299, 316, 358, 424, SL-502 and SL-503 have been designated as paratypes. The paratypes have the following collection data: Coll. 189, SRI LANKA, Galle Dist., Kanneliya, Sinharaja Forest, 8 July 1975, Peyton & Huang; Coll. 205, 209, 213 and 214, SRI LANKA, Galle Dist., Kanneliya nr bungalow, 9 July 1975, Peyton & Huang; Coll. 237, 238 and 239, SRI LANKA, Galle Dist., Kanneliya, Sinharaja Forest, 10 July 1975, Peyton & Huang; Coll. 299, SRI LANKA, Ratnapura Dist., Weddagala, Sinharaja Forest, 17 July 1975, Peyton & Huang; Coll. 358, SRI LANKA, Ratnapura Dist., Weddagala, Sinharaja Forest, 23 July 1975, Peyton & Huang; Coll. 316, SRI LANKA, Kalutara Dist., Morapitiya, Sinharaja Forest, 18 July 1975, Peyton & Huang; Coll. 424, SRI LANKA, Colombo Dist., Labugama Reservoir, 7 Aug 1975, Peyton & Huang; Coll. SL-502, SRI LANKA, Ratnapura Dist., Sinharaja Forest, 4 May 1986, V.L. Kulasekera; Coll. SL-503, SRI LANKA, Ratnapura Dist., Sinharaja Forest, 7 May 1986, V.L. Kulasekera.

The type locality of *An. peytoni* is Kanneliya Forest Reserve in the Galle District of Sri Lanka. The type collections were made from side pools on a stream (Coll. 189 & 205); margin of a stream (Coll. 214 & 237); rock pool with leaves (Coll. 209, 213, and 424); ditch on the roadside (Coll. 238); elephant footprint in swamp (Coll. 239); gem pit (Coll. 299 & 358); flood pool (Coll. 316); semipermanent ground pool (Coll. SL-502 & SL-503); at 245 m (Kanneliya Forest Reserve), 305 m (Labugama Forest Reserve), 346 m (Morapitiya Forest Reserve) and 610 m (Sinharaja Forest Reserve) elevations.

The holotype and allotype of *peytoni* listed above and the paratypes listed below are deposited (with associated slides) in the USNM: 209 (L), 209 (L), 214 (L), 214 (L), 237 (L), 238 (L), 239 (L), 316 (L), 358 (L), 205-100 (♂), SL-502-16 (♂), SL-502-21 (♂), SL-503-27 (♂), 209-1 (♀), 238-3 (♀), 358-4 (♀), 358-5 (♀), 424-102 (♀), SL-503-1 (♀), SL-502-6 (♀), SL-502-7 (♀) and SL-502-8 (♀).

The following paratypes are deposited as below: 2 males (237-1 and 338-104), 2 females (238-2 & 358-7) with associated larval and pupal exuviae on slides and 2 whole larvae (239 & 189) deposited at the British Museum (Natural History) [BM(NH)]; 2 males (213-100 & SL-502-14), 2 females (238-5 & 358-100) with associated larval and pupal exuviae on slides and 2 whole larvae (239 & 299) deposited at the Department of Zoology, University of Peradeniya, Sri Lanka; 2 males (238-108 & SL-503-26), 2 females (239-5 & 358-8) with associated larval and pupal exuviae on slides and 2 whole larvae (239 & 214) deposited at the Centre for Research in Medical Entomology, Madurai, India.

DISCUSSION. During this study, *peytoni* was compared with specimens of the other known species of the Aitkenii Group that are housed in the National Museum of Natural History (USNM), Smithsonian Institution. These included: *An. aberrans* Harrison and Scanlon, *acaci* Baisas, *aitkenii*, *bengalensis* Puri, *borneensis* McArthur, *fragilis* (Theobald), *insulaeflorum*, *palmatus* (Rodenwaldt), *pilinotum*, *stricklandi* Reid and *tigertti* Scanlon and Peyton. The only other species, *pinjaurensis* Barraud, is known only from the type male which was collected in Punjab, India. This specimen, deposited in the British Museum (Natural History), was examined by Harrison in 1972 and confirmed to have an exceptionally long aedeagus unlike any of the other Aitkenii Group species.

A search of the USNM, BM(NH) and Sri Lankan collections by the authors has not produced a single specimen of true *insulaeflorum* from Sri Lanka. Accordingly, we feel certain that *peytoni* is the "*An. insulaeflorum*" of authors from Sri Lanka.

Anopheles peytoni is a unique and well differentiated species that exhibits characters similar to several diverse members of the Aitkenii Group. Generally, the adult females of *peytoni* are most similar to *aitkenii*, *bengalensis*, *borneensis*, *fragilis*, *stricklandi* and *tigertti* females (all currently unidentifiable). The male genitalia of *peytoni* are most similar to those of *acaci*, but still distinct by the characters described below. The pupa of *peytoni* is most similar to the pupae of *pilinotum* and *insulaeflorum*, while the larva is more like the larvae of *insulaeflorum*, *pilinotum* and *stricklandi*.

The adults of *peytoni* have the general culicine-like habitus of most of the other members of the Aitkenii Group. They can be separated from *insulaeflorum* and *pilinotum* by having the prescutellar area bare instead of with fine setae as on the 2 latter species. Adults of *aberrans* and *palmatus* having different colored abdominal segments can also be separated from the unicolorous abdomen of the other species (including *peytoni*). Adults of *peytoni* are separated easily from *acaci* by the former having normal densely plumose antennae, while males of the latter have female-like antennae. Otherwise, adult *peytoni* cannot be separated from the other Aitkenii Group species except by male genitalia characters.

The aedeagus of *peytoni* is quite distinct from the other species of the group except *acaci*, *insulaeflorum*, *pilinotum* and *tigertti*. B.A. Harrison examined a paratype of *An. acaci* at the BM(NH) with the male genitalia slide bearing the following data: "*An. acaci*" on the 1st line; "A-11, vi-40" on the 2nd line; "Philippines" on the 3rd line; "Baisas" on the 4th line; and "adult in drawer" on 5th line. His notes on the paratype

state: "3 stout outer setae, club appears to come from a single stem, ventral lobe with 2 large spines [setae] and 3-5 smaller spines [setae] on ventral side, aedeagus abruptly narrows near apex". This specimen resembles Reid's (1968: 242, fig. 119a) illustration except the shape of the aedeagus is slightly different, and the inner dorsal club on the specimen is larger than Reid illustrated. Also, the internal seta of the gonocoxite of *acaci* is inserted approximately 0.67 from the base, not approximately 0.80 from the base as is normal for the Aitkenii Group. The shape of the aedeagus of *acaci* drawn by Harrison strongly resembles that of *peytoni*, except that the former lacked the spines prominent on *peytoni*.

The aedeagus of *peytoni* has small spines and is therefore different from all other members of the Aitkenii Group, except *insulaeflorum*, *pilinotum* and *tigertti* which also have small spines on the aedeagus. It can be separated from these last 3 named species by the shape of the aedeagus which narrows abruptly at the apex into a ventrally-bent hood in *peytoni*, but tapers evenly and lacks this hood in the other 3 species.

Harrison and Scanlon (1974: 33) attributed the male genitalia illustrations of *insulaeflorum* in Christophers (1933: 104, fig. 17) to *pilinotum*. However, the similarities of those illustrations and the shape of the aedeagus of *peytoni* lead us to speculate that Christophers used either Sri Lankan or southern Indian specimens for his illustrations, rather than Philippine specimens. Accordingly, Christophers (1933) may have been the first person to illustrate *peytoni*. The larval illustration of "*insulaeflorum*" in Carter (1925) possibly represents a specimen of *aitkenii* with both setae 2-C simple, because the bases of the 2-C, if accurately drawn, are too widely separated to represent *peytoni*.

In the pupal stage, *peytoni* has more morphological similarities to *insulaeflorum*, *pilinotum* and *stricklandi* than to the remaining species of the Aitkenii Group. The pupa of *An. peytoni* resembles the pupa of *insulaeflorum* except in the branching of seta 6-II and the length ratio, paddle fringe/1-P. In *peytoni*, 6-II has 3-6 branches and the fringe is 0.68-0.95 the length of 1-P, while 6-II is simple or bifid and the fringe is only 0.35 the length of 1-P in *insulaeflorum*. Additionally, the refractile margin of *peytoni* is short (0.4-0.5) and seta 6-I has 3-5 branches, while *insulaeflorum* has the refractile margin long (0.50-0.67) and 6-I with 2-3 branches.

The pupa of *peytoni* is easily separated from that of *pilinotum* by the former having 6-III single to 3 branched, the length ratio, paddle fringe/1-P, 0.68-0.95 and the outer margin of the distal half of the paddle slightly convex. *Anopheles pilinotum* has 6-III with 3-6 branches, the paddle fringe/1-P ratio, 0.5-0.6 and the outer margin of the distal half of the paddle straight or nearly straight. The pupa of *peytoni* can be separated from that of *stricklandi* by the former having 1-III with 5-13 branches, while 1-III of *stricklandi* has 3-6 branches. In addition, setae 9-IV-VIII on *stricklandi* are considerably shorter than those of *peytoni* and the other members of the Aitkenii Group.

Anopheles aitkenii, the only other member of the group occurring with *peytoni* in Sri Lanka, has a pupa with a long paddle refractile margin (0.6), seta 1-IV with 2-5

branches and 9-IV with a blunt rounded tip. The pupa of *peytoni* has a shorter refractile margin (0.4-0.5), 1-IV with 5-9 branches and 9-IV with a sharp tip.

The larva of *peytoni* can be separated from all the species of the Aitkenii Group, except *insulaeflorum*, *palmatus*, *pilinotum* and *stricklandi*, in having both setae 2-C very close together and simple. The other species (*aberrans*, *acaci*, *aitkenii*, *bengalensis*, *borneensis*, *fragilis* and *tigertti*) normally have both 2-C separated by a distance approximately equal the distance between 2-C and 3-C on one side. In addition, 2-C on these species normally has 2 or more branches, however, infrequent specimens of *aitkenii*, *bengalensis*, *fragilis* have been seen with both 2-C unbranched. In general, *peytoni* resembles the larva of *insulaeflorum* and *stricklandi*, but differs in the branching of 11-II and 1-X. In *peytoni* 11-II has 2-4 branches, while both of these setae are simple in *insulaeflorum* and *stricklandi*. Additional characters that will separate *peytoni* from these 2 species are: *peytoni* 6-A 7-11 branches and 9-C 5-9 branches; *insulaeflorum* and *stricklandi* 6-A 4-7 branches and 9-C 3-6 branches. *Anopheles peytoni* differs from *pilinotum* in having 11-II with 2-4 branches and 1-I filamentous, while 11-II is simple and 1-I has leaflets on the latter. The larva of *palmatus* is easily distinguished by the presence of large anterior tergal plates on the abdomen and 6-III with 18-27 branches, while *peytoni* has small anterior tergal plates and 6-12 branches on 6-III.

The larva of *aitkenii*, the only other Aitkenii Group species occurring in Sri Lanka, normally has both 2-C widely separated and bifid or trifid and 6-III with 20 or more branches, while *peytoni* has 2-C close together and simple and 6-III with 5-12 branches.

We take great pleasure in naming this species in honor of our friend, E.L. Peyton, for making the excellent collections of this species in 1975, and for his many superb contributions to our knowledge of the *Anopheles* of Asia, particularly the Dirus Complex.

DISTRIBUTION. Based on the 69 collections of *An. peytoni* that we have examined this species is restricted to wetzone forested habitats between 245-610 m elevation in Sri Lanka. However, Christophers (1921) discussed and mapped the various zoogeographical zones for the Indian subregion and showed Sri Lanka belonging to a Malabar-Ceylon area, including the southern tip of India and an area extending up the Western Ghats and the Malabar strip to a point north of Bombay. Ramachandra Rao (1984) in discussing records of *insulaeflorum* from India, listed 2 basic areas where this species has been recorded: the northeastern region and the Western Ghats in southern India. Harrison and Scanlon (1975) examined and confirmed true *insulaeflorum* specimens from Assam; however, specimens from southern India were not available for study. Collections by the late M.B. Mohan from the Nilgiri Hills of southern India are present in the USNM, but only contain true *aitkenii*. Despite this lack of specimens we suspect that the records (Christophers 1933, Brooke Worth 1953, Ramachandra Rao 1984) of *insulaeflorum* from the Western Ghats of India may actually refer to *peytoni*. This distribution, if proved, would be very similar to those species of the Leucosphyrus Group of *An. (Cellia)* and the Gigas and Lindesayi Groups of *An. (Anopheles)* in the Indian subregion.

During this study, a total of 248 specimens of *peytoni* were examined (26♂, 37♀, 64 whole larvae, 54 larval skins and 67 pupal skins). Data for these specimens are as follows: SRI LANKA: Galle District, Kanneliya Forest Reserve, Coll. 188, 8 July 1975, side pool on stream, Peyton & Huang, 2♀, 2L, 1l, 2p; Coll. 189, 8 July 1975, side pool on stream, Peyton & Huang, 3L; Coll. 193, 8 July 1975, side pool on stream, Peyton & Huang, 1L; Coll. 200, 9 July 1975, small rock pool, Peyton & Huang, 1♀, 1p; Coll. 205, 9 July 1975, stream pool, Peyton & Huang, 1♂, 6L, 2l, 1p; Coll. 206, 9 July 1975, stream pool, Peyton & Huang, 1p; Coll. 209, 9 July 1975, rock pool, Peyton & Huang, 1♀, 2L, 1l, 1p; Coll. 211, 9 July 1975, rock pool, Peyton & Huang, 1♀, 1L, 1l, 1p; Coll. 212, 9 July 1975, rock pool, Peyton & Huang, 1♀, 1L, 1l, 1p; Coll. 213, 9 July 1975, rock pool, Peyton & Huang, 2♂, 1l, 1p; Coll. 214, 9 July 1975, stream margin, Peyton & Huang, 2♀, 1♂, 8L, 2l, 2p; Coll. 218, 10 July 1975, elephant footprint, Peyton & Huang, 2L, 1l; Coll. 220, 10 July 1975, elephant footprint, Peyton & Huang, 2L; Coll. 221, 10 July 1975, elephant footprint, Peyton & Huang, 1L; Coll. 237, 10 July 1975, stream margin, Peyton & Huang, 4♀, 3♂, 3L, 5l, 7p; Coll. 238, 10 July 1975, roadside ditch, Peyton & Huang, 6♀, 6♂, 16L, 9l, 16p; Coll. 239, 10 July 1975, elephant footprint, Peyton & Huang, 3♀, 6L, 3l, 3p; Ratnapura District, Sinharaja Forest Reserve: Coll. 299, 17 July 1975, ground pool, Peyton & Huang, 3L; Kalutara District, Morapitiya Forest Reserve: Coll. 316, 18 July 1975, flood pool, Peyton & Huang, 2L; Coll. 358, 23 July 1975, gem pit, Peyton & Huang, 6♀, 5L, 5l, 6p; Colombo District, Labugama Forest Reserve: Coll. 424, 7 August 1975, rock pool, Peyton & Huang, 1♀, 1p; Ratnapura District, Sinharaja Forest Reserve: Coll. SL-502, 4 May 1986, ground pool, V.L. Kulasekera, 9♀, 8♂, 18l, 19p; Coll. SL-503, 7 May 1986, ground pool, V.L. Kulasekera, 2♂, 2l, 2p; Coll. SL-504, 9 May 1986, seepage marsh, V.L. Kulasekera, 2♂, 1l, 1p; Coll. SL-505, 12 May 1986, ground pool, V.L. Kulasekera, 1♂, 1l, 1p.

BIONOMICS. Based on data collected between 1975 and 1986, *An. peytoni* can be categorized as a lowland wetzone forest species. Collections were made in partial to heavily shaded areas from 4 different southwestern lowland wetzone rain forests (Kanneliya Forest Reserve, Sinharaja Forest Reserve, Morapitiya Forest Reserve, and Labugama Forest Reserve) at elevations from 245 to 610 m. The immatures were collected from: side pools or streams with water running through debris, i.e., dead leaves and sticks (5); rock pool with debris (13); stream margin of a shallow slow moving stream with debris (5); elephant footprints in a small swamp (4); gem pit with debris (2); flood pool (1); semipermanent small ground pools with debris (21); ditch on the roadside (1); seepage marsh with debris (17); and among green algae found in the stream pools and along the stream margin (5).

Other mosquito species associated with *An. peytoni* in these immature collections were: *Anopheles (Cellia) elegans* (James), (semipermanent ground pool, gem pit; temporary flood pool); *Uranotaenia (Uranotaenia) rutherfordi* Edwards (seepage marsh, elephant footprint in swamp); *Ur. (Pseudoficalbia) bicolor* Leicester (rock pool, stream margin, elephant footprint in swamp, semipermanent ground pool); *Ur. (Pfc.) gouldi* Peyton and Klein (rock pool, seepage marsh); *Aedes (Finlaya) chrysolineatus* (Theobald) (rock pool); *Ae. (Verrallina) pseudomediofasciatus* (Theobald) (semipermanent ground pool); *Culex (Lutzia) halifaxi* Theobald (stream margin, elephant footprints in a swamp); *Cx. (Lophoceraomyia) lasiopalpis* Sirivarnakarn (elephant footprint in swamp); *Cx. (Lop.) uniformis* (Theobald) (rock pool); *Cx. (Lop.) wardi* Sirivarnakarn (rock pool, stream margin, semipermanent ground pool); *Cx.*

(*Culiciomyia pallidothorax* Theobald (rock pool); *Cx. (Culex) bitaeniorhynchus* Giles (small stream pool with green algae, ditch on the roadside with green algae); *Cx. (Cux.) infula* Theobald (stream margin with green algae); *Cx. (Cux.) mimulus* Edwards (gem pit, semipermanent ground pool); *Cx. (Cux.) pseudovishnui* Colless (semipermanent ground pool).

One aspect of the bionomics of *An. peytoni* deserves special attention. Adult females of *peytoni* apparently bite man. Twenty-one females were collected biting man from April to September 1985, during a survey conducted to determine the diurnal-biting mosquito species in an undisturbed part of the Sinharaja Forest. These females were captured between 0900-1100 and 1400-1600 hr on the following dates: 6 May, 2 June, 7 July, 3 August, and 3 September. We cannot prove absolutely that these females were *peytoni*, because isolated females failed to oviposit and thus, produce immatures for positive identification. However, during 2 1/2 years of mosquito collecting in the Sinharaja Forest, *aikenii* the only other Aitkenii Group member in Sri Lanka, has never been collected, either as adults or immatures. Christophers (1933) and Amerasinghe (1982) are apparently the only references from the Indian Subregion that mention an Aitkenii Group species (as *aikenii*) biting man.

Anopheles peytoni females exhibit a culicine-like resting and biting posture like that seen in members of the Culicifacies Complex of *Anopheles (Cellia)*. This posture and the size of *peytoni* are similar to those of *Anopheles culicifacies* Giles (species B of Green and Miles 1980), the recognized primary vector of human malaria parasites in Sri Lanka. Collectors making resting collections in or near forested areas of Sri Lanka should be alert that 3 species with this posture (*aikenii*, *culicifacies* and *peytoni*) may be collected.

ACKNOWLEDGMENTS. We gratefully acknowledge the funding of portions of this work through the Office of Fellowships and Grants, Smithsonian Institution, Washington, DC. We are most grateful to Karl V. Krombein, Department of Entomology, National Museum of Natural History, Washington, DC, for serving as advisor for the senior author, and for reviewing the manuscript. We are very grateful to Ellen Allers, Mosquito Information Management Project, Smithsonian Institution, Washington, DC, for computer assistance, Ronald A. Ward, Walter Reed Army Institute of Research, Washington, DC, for reviewing the manuscript, Taina Litwak, WRBU, for preparing the illustrations and James Pecor, WRBU, for technical assistance and preparing the manuscript for photoreproduction.

REFERENCES CITED

- Amerasinghe, F.P. 1982. Observations on the mosquitoes (Diptera: Culicidae) of Udawattakele Forest, Sri Lanka. *J. Natn. Sci. Coun. Sri Lanka* 10: 81-97.
- Brooke Worth, C. 1953. Notes on the anopheline fauna of a hill tract in Mysore State, India. *Indian J. Malariol.* 7:125-182.
- Carter, H.F. 1925. The anopheline mosquitoes of Ceylon. Part 1. The differential characters of the adults and larvae. *Ceylon J. Sci. (D)* 1: 57-97.
- Carter, H.F. 1950. Ceylon mosquitoes: Lists of species and names of mosquitoes recorded from Ceylon. *Ceylon J. Sci. (B)* 24: 85-115.
- Christophers, S.R. 1921. The distribution of mosquitoes in relation to the zoogeographical areas of the Indian Empire, pp. 205-215. *In*: T.B. Fletcher, (ed.). *Proceedings of the Fourth Entomological Meetings, Pusa, India.* 401 p.
- Christophers, S.R. 1933. The fauna of British India, including Ceylon and Burma. Diptera. Vol. IV. Family Culicidae. Tribe Anophelini. Taylor and Francis, London. 371 p.
- Chow, C.Y., E.S. Thevasagayam and K. Tharumarajah. 1954. Insects of public health importance in Ceylon. *Rev. Ecuat. Entomol. Parasitol.* 2: 105-150.
- D'Abrera, V. St. E. 1944. The eggs of the Ceylon anopheline mosquitoes. *J. Malaria Inst. India* 5: 337-359.
- Green, C.A. and S.J. Miles. 1980. Chromosomal evidence for sibling species of the malaria vector *Anopheles culicifacies* Giles. *J. Trop. Med. Hyg.* 83: 75-78.
- Harbach, R.E. and K.L. Knight. 1980. *Taxonomists' glossary of mosquito anatomy.* Plexus Publishing, Inc., Marlton, New Jersey. 415 p.
- Harbach, R.E. and K.L. Knight. 1982. Corrections and additions to Taxonomists' Glossary of Mosquito Anatomy. *Mosq. Syst.* 13: 201-217.
- Harrison, B.A. and J.E. Scanlon. 1974. *Anopheles (An.) pilinotum*, a new species name in the *aikenii* Complex for *An. insulaeflorum* from the Philippines and eastern Indonesia (Diptera: Culicidae). *Mosq. Syst.* 6: 32-40.
- Harrison, B.A. and J.E. Scanlon. 1975. Medical entomology studies II. The subgenus *Anopheles* in Thailand (Diptera: Culicidae). *Contrib. Am. Entomol. Inst. (Ann Arbor)*. 12(1): 1-307.
- James, S.P. 1903. *Anopheles aikenii*, n. sp., p. 22. *In*: F. V. Theobald, A monograph of the Culicidae or mosquitoes. Vol. III, Br. Mus. (Nat. Hist.), London. 359 p.

- Jayasekera, N. and R.V. Chelliah. 1981. An annotated checklist of mosquitoes of Sri Lanka (Diptera: Culicidae). MAB-UNESCO- Man and the Biosphere National Committee of Sri Lanka. Publ. No. 8: 1-16.
- Knight, K.L. and A. Stone. 1977. A catalog of the mosquitoes of the world (Diptera: Culicidae). 2nd edition. Thomas Say Found., Entomol. Soc. Am. 6: 1-611.
- Puri, I.M. 1930. A note on two species of Indian anopheline mosquitoes - *A. insulaeflorum* Swellengrebel and *A. aitkenii* James, with its variety *bengalensis* nov. var. Indian J. Med. Res. 17: 953-956.
- Puri, I.M. 1948. The distribution of anopheline mosquitoes in India, Pakistan, Ceylon and Burma: Part V: Additional records, 1936-47. Indian J. Malariol. 2: 67-107.
- Ramachandra Rao, T. 1984. The anophelines of India. (Revised edition). Malaria Research Center, Indian Council of Medical Research, Delhi. 518 p.
- Reid, J.A. 1965. A revision of the *Anopheles aitkenii* group in Malaya and Borneo. Ann. Trop. Med. Parasitol. 59: 106-125.
- Reid, J.A. 1968. Anopheline mosquitoes of Malaya and Borneo. Stud. Inst. Med. Res. Malaya 31: 1-520.
- Stone, A., K.L. Knight and H. Starcke. 1959. A synoptic catalog of the mosquitoes of the world (Diptera: Culicidae). Thomas Say Found., Entomol. Soc. Am. 6: 1-358.
- Swellengrebel, N.H. and J.M.H. Swellengrebel-de Graaf. 1920. Addendum to description of larvae of Netherland's Indian anophelines. Meded. Burgerl. Geneesk. Dienst Ned.-Ind. 9: 1-3.

Table 1. Number of branches for pupal setae of *Anopheles (Ano.) peytoni*.^a

Seta Number	CT	Abdominal Segments								Paddle	
		I	II	III	IV	V	VI	VII	VIII	IX	P
0	-	-	1	1,2(1)	1-3(1)	1,2(1)	1,2(1)	1,2(1)	1	-	-
1	3-5(3) ^b	1	6-12(10)	5-13(8)	5-9(7)	3-6(4)	3-5(4)	3-5(3)	-	1	1
2	3-5(4)	6-10(7)	2-4(3)	3-5(4)	2,3(3)	2,3(2)	2-4(2)	2-4(3)	-	-	2-5(3)
3	4-6(5)	1	2-6(5)	4-6(4)	3-7(5)	2-5(3)	1-3(2)	2,3(3)	-	-	-
4	4,5(5)	3-7(6)	4-6(4)	3-5(4)	3-5(4)	2-5(3)	2,3(2)	2,3(2)	2-5(3)	-	-
5	4-7(5)	2-5(3)	3,4(4)	4-8(7)	4-7(5)	7-10(7)	7-9(9)	9-13(11)	-	-	-
6	3,4(3)	3-5(4)	3-6(4)	1-3(3)	2-4(3)	2,3(2)	1-3(1)	1-3(2)	-	-	-
7	3-6(4)	3-9(5)	3-6(5)	2-5(4)	2-6(4)	2-4(3)	1,2(1)	1-3(2)	-	-	-
8	1-3(2)	-	0,1(0)	1-4(2)	1-3(2)	1-3(2)	2,3(3)	1-3(2)	-	-	-
9	4-6(5)	1	1	1	1	1	1	1	12-20(12)	-	-
10	1-4(2)	-	-	2-5(2,3) ^c	1-3(3)	2-4(3)	1-3(3)	2-4(2)	-	-	-
11	2-4(3)	-	-	1,2(1)	1	1,2(1)	1	2,3(2)	-	-	-
12	3-5(3)	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	1,2(1)	1	1	1	1	1	-	-

^a Minimum of 10 checked for each seta.^b Range (mode).^c Two modal numbers.

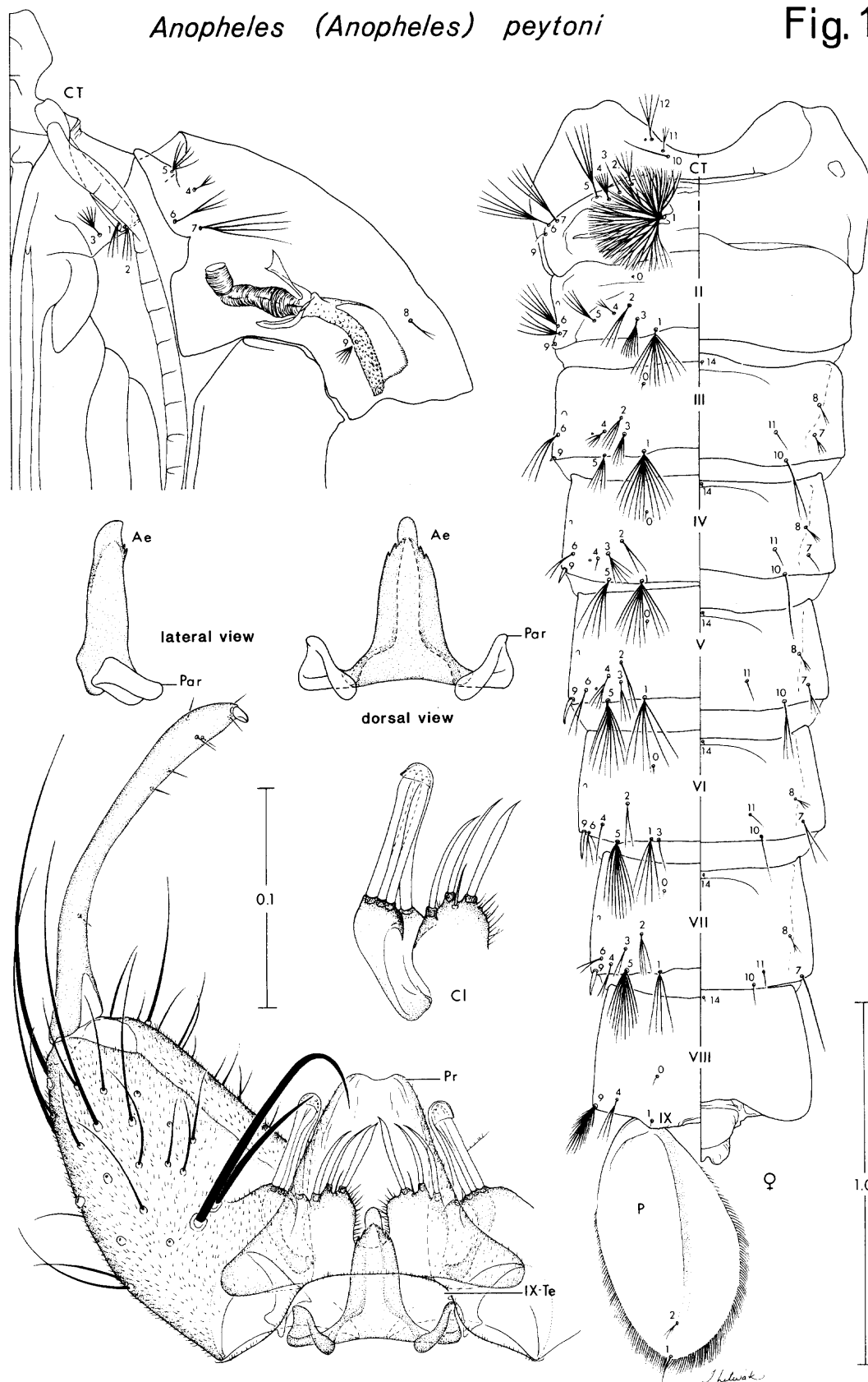
Table 2. Number of branches for setae of the fourth-instar larva of *Anopheles (Ano.) peytoni*.^a

Seta Number	Head C	P	Thorax M	T	I	II	III	IV	V	VI	VII	VIII	X
0	-	1	-	-	-	1-3 (2)	1,2 (2)	1-3 (2)	1-3 (2)	1-3 (2)	1-3 (2)	1-4 (3)	-
1	1	8-11 (8)	24-33 (26)	1,2 (1)	7-13 (9)	9-18 (14)	13-19 (15)	14-20 (15)	12-20 (14)	12-16 (14)	10-16 (14)	1-3 (2)	2-4 (3)
2	1	9-16 (12)	1,2 (1)	1	3-7 (4,5)	6-9 (6)	4-7 (5)	1,2 (1)	1-3 (1)	4-7 (5)	6-11 (7)	8-17 (13)	12-26 (21)
3	1,2 (1) ^b	1	1	11-15 (11)	2-4 (3)	1,2 (1)	1	1-4 (2)	1	1	2-5 (4)	12-20 (14)	10-15 (12)
4	4-6 (5)	12-20 (17)	3-5 (4)	3,4 (3)	3-8 (6,7)	6-10 (6)	2-5 (3,4)	2-4 (3)	2,3 (2)	1,2 (1)	1-4 (1)	1-3 (2)	7-10 (9)
5	7-13 (9)	24-38 (30)	1,2 (1)	26-35 (27)	5-10 (7)	8-12 (11)	4-9 (8)	4-9 (6,7)	9-14 (13)	10-15 (15)	10-17 (13)	5-10 (7)	-
6	9-14 (11)	1	2-5 (3)	2-4 (3)	19-26 (25)	21-29 (24)	6-12 (7)	3-5 (4)	4-6 (5)	4-8 (5)	3-10 (5)	1-S (9)	7-10 (9)
7	13-19 (17)	15-24 (20,21)	2-4 (3)	19-24 (21,22)	16-25 (19)	20-26 (22)	6-10 (8)	6-11 (7)	5-9 (7)	4-7 (6)	6-13 (10)	2-S (10,12)	8-15 (10,12)
8	3-6 (3,4) ^c	25-36 (28)	13-23 (17)	17-28 (17)	-	1,2 (1)	1,2 (2)	1-3 (2)	3-7 (4,5)	5-7 (5)	4-8 (6)	4-S (5)	1
9	5-9 (8)	1	1	1	6-11 (8,9)	10-18 (14)	8-14 (10)	8-14 (11)	9-15 (12)	8-14 (10)	5-11 (7)	5-S (6)	1
10	2-5 (3)	1	1	1	1,2 (2)	4-7 (5)	2-5 (3)	2-4 (3)	2-4 (3)	3-6 (4)	3-7 (5)	6-S (7)	2-4 (3)
11	30-39 (37)	1	1	1	4-7 (5)	2-4 (2)	2-5 (3)	2-5 (3)	2-4 (3)	2-4 (3)	2,3 (2)	7-S (8)	1,2 (2)
12	3-5 (4)	1	1	2-4 (3)	2-5 (3)	2-5 (4)	2-4 (3)	2-7 (4)	2-4 (4)	2-4 (2)	2-4 (3)	8-S (5)	4-6 (5)
13	8-13 (8)	4-9 (7)	3-6 (4)	3-5 (4)	6-12 (8)	7-15 (10,12)	9-15 (10)	9-15 (11)	4-9 (6)	6-14 (11)	4-9 (6)	9-S (1)	1-3 (2)
14	2-5 (3)	3-7 (5)	6-11 (7,9)	-	-	-	1,2 (1)	1,2 (1)	1-3 (1)	1-3 (2)	1,2 (1)	1,2 (1)	-
15	1	-	-	-	-	-	-	-	-	-	-	-	-

^a Minimum of 10 checked for each seta.^b Range (Mode).^c Two modal numbers.

Anopheles (Anopheles) peytoni

Fig. 1



Anopheles (Anopheles) peytoni

Fig. 2

