

DESCRIPTION OF THE PUPA OF *ANOPHELES* (*ANOPHELES*) *SINTONI* (DIPTERA: CULICIDAE)

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ABSTRACT. The pupa of *Anopheles* (*Anopheles*) *sintoni* Puri is described, illustrated for the first time, and compared to *An. sintonoides* Ho.

INTRODUCTION

The larval and adult stages of *Anopheles* (*Anopheles*) *sintoni* were described by Puri (1929) from the western coast of India. In spite of thorough studies in the same area by Covell and Harbhagwan (1939), Viswanathan (1950, quoted in Ramachandra Rao 1984:235) and Brooke Worth (1953), this species was not collected again. However, some additions were made to the descriptions from the original specimens in reviews of the species of *Anopheles* (*Anopheles*) by Christophers (1933), Reid (1968), Harrison and Scanlon (1975) and Ramachandra Rao (1984). However, the pupal stage of *An. sintoni* remained undescribed. Recently, the importance of morphological studies of the pupal chaetotaxy of anophelines was emphasized by Harrison and Peyton (1984). Thus, a description and illustrations of the pupal stage of *An. sintoni* are presented here, based on specimens collected in the Western Ghats in southern India.

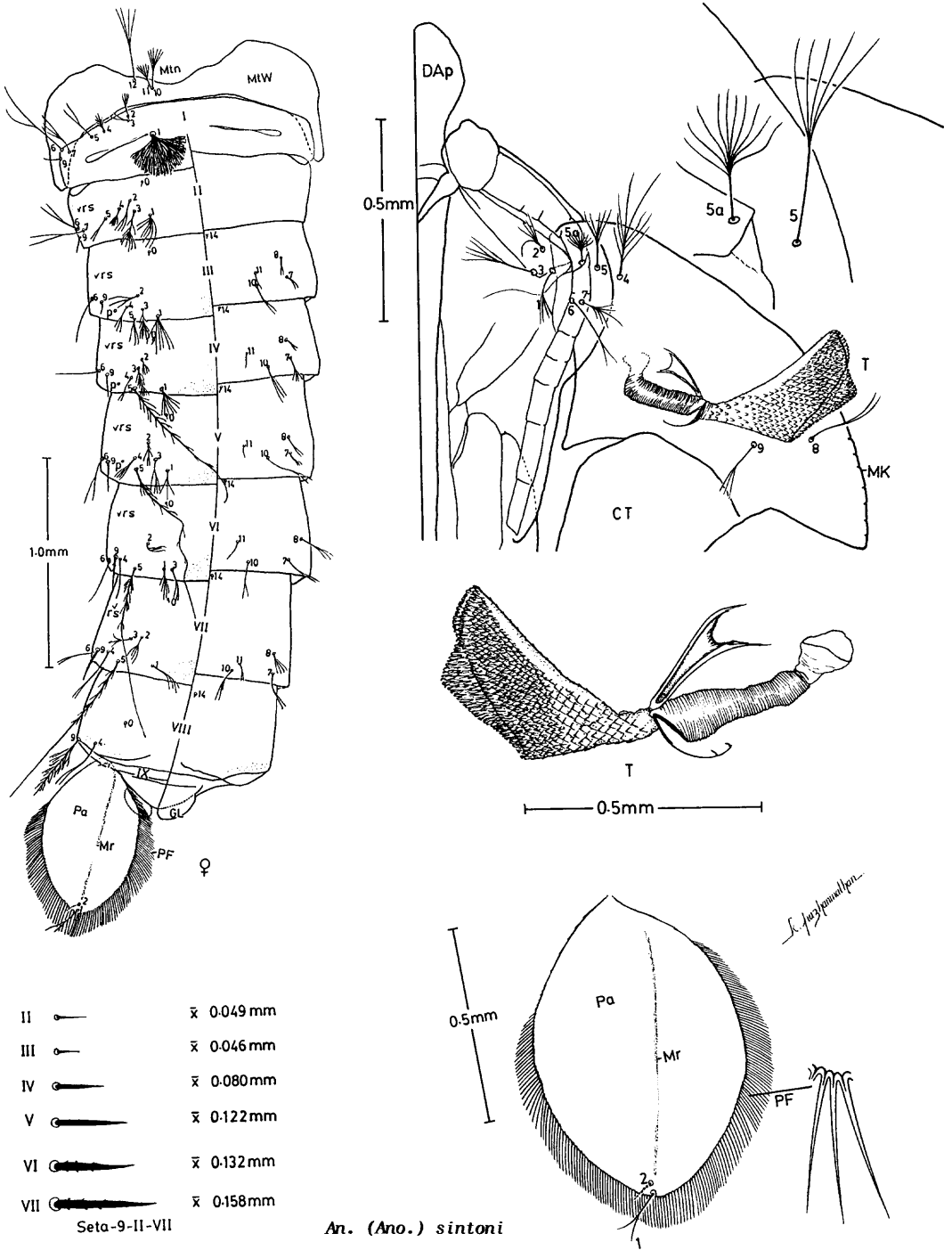
The terminology used follows Harbach and Knight (1980, 1982). Abbreviations of generic and subgeneric names are from Reinert (1975) and Bickley and Ward (1989). The range in the setal branching number is followed by the mode in parenthesis.

TAXONOMIC TREATMENT

Anopheles (*Anopheles*) *sintoni* Puri

Pupa (Fig. 1). Chaetotaxy and measurements based on 11 pupal exuviae which have associated adult specimens. Characters and

positions of setae as figured; range and modal number of branches in Table 1. *Cephalothorax*: Seta 5-CT with 2-5 branches; 6-CT with 2-4(2) branches; 7-CT with 2-10(6) branches, shorter than 6-CT; 10-CT with 2-6(6) branches; 12-CT with 3-6 branches; an additional seta on prothorax, closer to 5-CT, named 5a-CT, with 3-10 branches (this seta present in all specimens examined). *Trumpet*: Moderately pigmented, conical, with rounded meatal cleft; meatus 0.50-0.62 length of trumpet; index 2.0. *Abdomen*: Moderately spiculate medially on dorsum. Seta 0-II-VIII minute, single; seta 1-I dendritic with 9-13 main branches; 6-I with 1-3(2) branches; 7-I with 3-6(3) branches; 9-I short, with 1,2(1) branches; 1-II with 3-12 branches; 9-II short, always single; 1-III with 2-7(6) branches; 5-III with 2-6(3) branches; 6-III with 1-3(1) branches; 9-III short, single; 1-IV with 2-7 branches; 5-IV strong, about 1.4-1.7 length of segment, central stem with 14-23 fine branches; 6-IV with 1,2(1) branches; 9-IV single, short, thick, spine-like; 1-V with 2-5(3) branches; 5-V strong, about 1.5-2.0 length of segment, central stem with 10-25 fine branches; 6-V with 1,2(1) branches; 9-V single, long, thick, spine-like; 1-VI with 2-5 branches; 5-VI strong, long, about 1.5-2.0 length of segment, central stem with 4-22 fine branches; 6-VI with 1-4(1) branches; 7-VI with 1-5(2) branches, mesal to 8-VI; 9-VI single, long, thick, spine-like, usually acuminate; 1-VII with 2-5(4) branches; 5-VII strong, long, about 1.5-1.7 length of segment, central stem with 4-14 fine branches (in one specimen central stem bifid with 8 fine branches);



An. (Ano.) sintoni

Fig. 1. *Anopheles (Anopheles) sintoni*. Pupa. CT = cephalothorax, DAp = dorsal apotome, GL = genital lobe, MK = median keel, Mr = midrib, Mtn = metanotum, MtW = metathoracic wing, P = abdominal puncture, Pa = paddle, PF = paddle fringe, rs = rudimentary spiracle, T = trumpet, I-IX = abdominal segments.

Table 1. Chaetotaxy of pupa of *Anopheles (Anopheles) sintoni* Puri (11 specimens).

Seta no.	Cephalothorax CT	Abdominal segments			
		I	II	III	IV
0	—	—	1	1	1
1	2-4 (4)	9-13	3-12	2-7 (6)	2-7
2	2-8 (5)	3-7	2-4 (3)	2-5 (3)	2-5 (4)
3	2-6 (5)	2, 3 (2)	5-10	5-13 (10)	6-10 (8)
4	5-11 (8)	5-8 (6)	3-6	2-4 (3)	1-3 (2)
5	2-5	1-3 (2)	1-3 (2)	2-6 (3)	14-23
5a	3-10	—	—	—	—
6	2-4 (2)	1-3 (2)	1, 2 (2)	1-3 (1)	1, 2 (1)
7	2-10 (6)	3-6 (3)	2-5	1-5 (2)	1-4 (3)
8	2-6 (2)	—	—	2-4 (2)	2-4 (2)
9	1-4 (3)	1, 2 (1)	1	1	1
10	2-6 (6)	—	—	2-4 (2)	1-5 (3)
11	3-8 (6)	—	—	1, 2 (1)	1, 2
12	3-6	—	—	—	—
13	—	—	—	—	—
14	—	—	—	1	1

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

6-VII with 2-4(2) branches; 9-VII single, long, thick, spine-like, usually aciculate; 9-VIII long, strong with 10-22 branches; 1-IX minute, single. *Paddle*: Oval, with minute serrations on basal 0.35-0.50 length of paddle, apically 0.50-0.65 of outer margin and 0.7-0.8 of inner margin densely fringed, longest spicule in fringe about 0.8 length of 1-P; mid-

rib moderately pigmented, terminates just before base of 2-P; seta 1-P with 1,2(2) branches, about 0.2 length of paddle; 2-P short, with 1-3(1) branches; index 1.50-1.68, mean = 1.6 (s.d. 0.07).

Taxonomy. *Anopheles sintoni* belongs to the *culiciformis* species group which was formed by Reid and Knight (1961), who included five

species: *An. alongensis* Venhuis, *An. culiciformis* Cogill, *An. kyondawensis* Abraham, *An. sintoni* and *An. sintonoides* Ho. Recently, *An. alongensis* was removed from this group and included in a new group, the *alongensis* group, along with *An. cucphuongensis*, a new species (Phan et al. 1990). The pupa of *An. sintoni* possesses all the major characters of the *culiciformis* species group, viz: trumpet shallow with rounded meatal cleft, meatus ranging from 0.50–0.67 length of trumpet; abdominal seta 1-V-VII small, with 2–5 branches and 5-IV-VII long, well developed; 1-P straight. *Anopheles sintoni* is similar to *An. sintonoides* but can be easily distinguished by 1-P, which is straight and not hooked, and an additional mesothoracic seta 5a-CT (Fig. 1). In addition there are some minor differences on *An. sintoni*: 9-VI, VII usually aciculate; 5-IV-VII always longer than segments (1.4–2.0 length of segment); fringe spicules on paddle long, longest spicule about 0.8 length of 1-P; 1-P about 0.18 length of paddle.

Anopheles sintoni is an endemic Indian species. Seta 7-VI on the abdomen is mesal to 8-VI, which is unusual and significant in the subgenus *Anopheles* in Asia (B.A. Harrison, personal communication).

Specimen data. One male (A275) with associated larval and pupal exuviae (l.78, p.80), one female (A331) with associated larval and pupal exuviae (l.99, p.93) deposited in the National Museum of Natural History, Smithsonian Institution, Washington, DC. One male (A273) with associated larval and pupal exuviae (l.76, p.78) deposited in the National Institute of Virology, Pune, India.

Distribution. Based on collections made in 10 localities in three hill ranges of the Western Ghats, southern India, a total of 173 specimens (56 males, 26 females, 67 fourth instar larvae, 11 larval exuviae, 11 pupal exuviae and 2 male genitalia) of *An. sintoni* were examined. Data for these specimens are as follows: *Agastya Hills*. Tamil Nadu, Tirunelveli District, Kannikatti Forest Range, 850 m, coll. 15-10-86, tree hole, 3 males, 3 l, 3 p. *Wynad Hills*. Kerala, Wynad District, Kalpatta Forest Range, Lakkidi, 600 m, coll. 24-

1-88, tree hole, 25 males, 5 females, 6 l, 6 p, 20 L, 1 male genitalia. *Coorg Hills*. Karnataka, Coorg District, Sampajee Forest Ranges, Bheemagundi, 500 m, coll. 12-10-88, tree hole, 19 males, 11 females, 2 l, 2 p, 18 L, 1 male genitalia; Devarakolli, 850 m, coll. 13-10-88, tree hole, 5 males, 7 females, 16 L; Glencoorg, 750 m, coll. 14-10-88, tree hole, 2 females, 1 L; Kadamakkal Forest Range, Marigundi, 500 m, coll. 15-10-88, tree hole, 1 male; Bhagamandala Forest Range, Patty, 850 m, coll. 19-10-88, tree hole, 1 male, 1 female, 1 L; Karike, 800 m, coll. 20-10-88, cut bamboo, 2 L; Makutta Forest Range, Kerty, 500 m, coll. 24-10-88, tree hole, 1 male, 2 L; near Verajpet, 900 m, coll. 27-10-88, tree hole, 1 male, 7 L.

Bionomics. Based on studies made between 1986 and 1988, immatures of *An. sintoni* occur in tree holes and were collected once in cut bamboo at ground level. This species occurs between 500 and 850 m in the Western Ghats. It was found as immatures in association with *Culex (Lophoceraomyia) minor* (Leicester), *Cx. (Lop.) uniformis* (Theobald), *Orthopodomyia anopheloides* (Giles), *Or. flavithorax* Barraud, and *Toxorhynchites (Toxorhynchites) splendens* (Wiedemann). In cut bamboo, *An. sintoni* larvae were collected with *Cx. (Culiciomyia) fragilis* Ludlow.

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