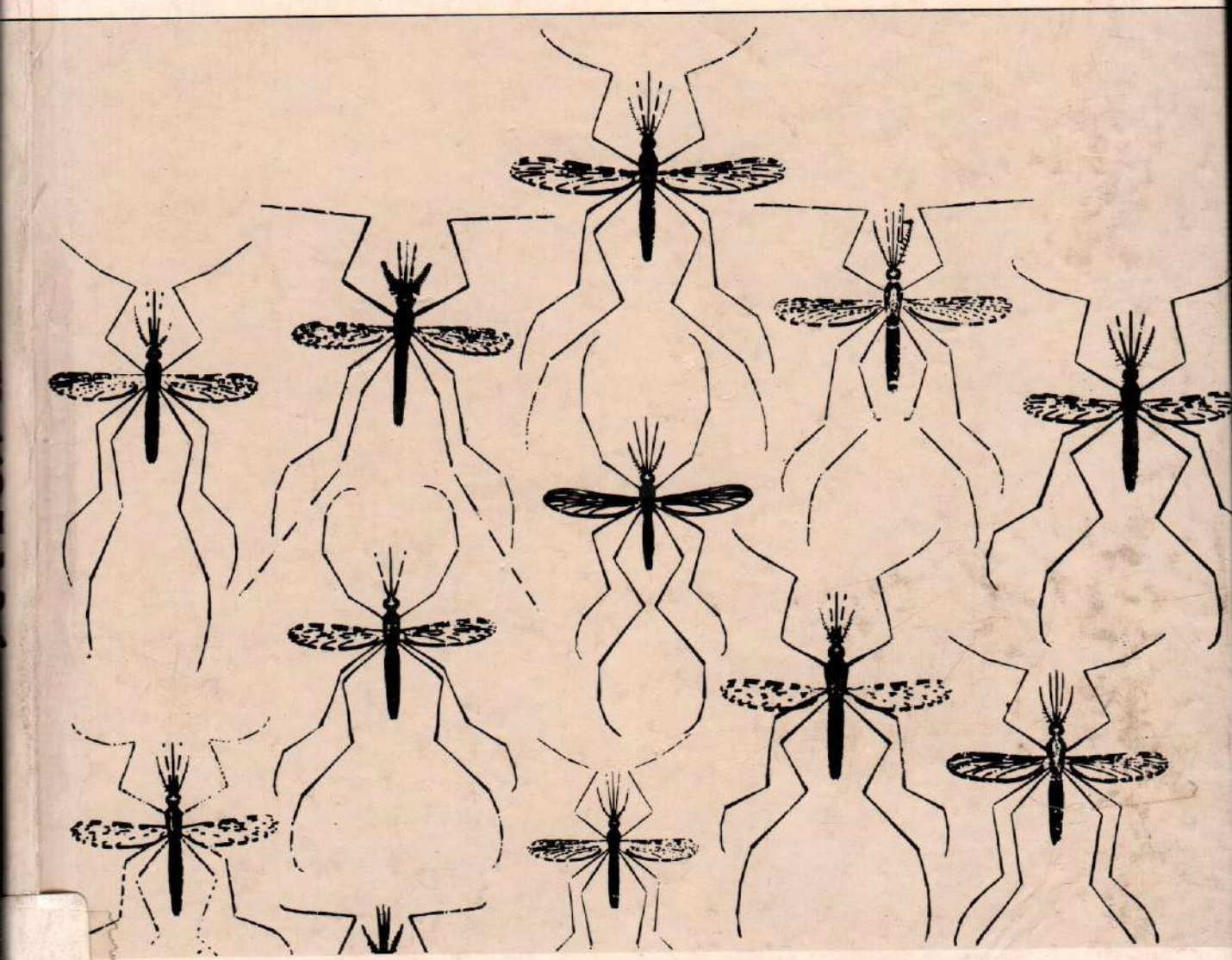
INDIAN ANOPHELINES



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PREFACE

Sometime around 1679, appeared in Italy the first book on mosquitoes. It took another 75 years or so before the first description of anopheline larva was made in 1754. Again it was not until 1897 when Sir Ronald Ross in India incriminated mosquitoes in malaria transmission that there was any taxonomic study of mosquitoes. The turn of the century however, marked a watershed in malarial studies: there was a tremendous upsurge of interest throughout the world on mosquito systematics. In 1933 an excellent publication on "anophelines" by Sir S.R. Christophers in the Fauna of British India series laid the foundation of taxonomic research. There have since been contributions that deserve mention, for example, the 'Vectors of Malaria in India' published by the National Society for Malaria and Other Communicable Diseases in 1957 and 'Anophelines of India' by T. Ramachandra Rao in 1984. Both these books were useful additions to our knowledge on mosquito systematics, biology and control. These are classic works no doubt, but unfortunately they have become outdated. There was therefore a felt need for a comprehensive book on the Indian *Anopheles* mosquitoes.

We therefore took up a study of Indian anophelines, spread over a decade and spanning both laboratory and field investigations. Embodying the results of our studies, this book provides keys to the identification of all *Anopheles* mosquitoes reported from India with detailed drawings of the species, geographical distribution and their role in disease transmission. We hope this book would be a useful manual to the students, researchers and those associated with malaria control. We also expect that this compilation would go a long way in our fight against vector borne diseases.

We thank Dr. R.A. Ward, Editor of the American Mosquito Control Association, Washington, USA for reviewing the manuscript and for making many useful suggestions. The art work was done by late (Mrs.) Meenu Talwar, who worked tirelessly in preparing the plates. Thanks are also due to Dr.(Mrs.) Aruna Srivastava, technical staff of the computer section, MRC and field staff for their help and cooperation.

December 1994

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V.P. SHARMA

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INTRODUCTION

Among insects, mosquitoes are the most important group; they transmit diseases such as malaria, filaria, dengue, Japanese encephalitis, and yellow fever. Knowledge of mosquitoes in India dates back to the second century. Susruta, in his famous work *Susruta Samhita*, described 12 kinds of life-destroying insects including mosquitoes and grouped them into Five categories — Samudrah, Parimandala, Hastimashaka, Krishna, and Parvatiya, on the basis of ecological, morphological, and causative characters. Sir Ronald Ross's discovery of malaria parasite oocystes in the gut of *Anopheles* mosquitoes in 1897 stimulated a great deal of interest leading to an upsurge of contributions on various aspects of mosquitoes.

Mosquitoes are characterized by a slender elongated body covered with scales and the possession of piercing and sucking mouth parts. The insects belong to the phylum Arthropoda, order Diptera, suborder Nematocera, family Culicidae, and subfamilies Anophelinae, Culicinae, and Toxorhynchitinae. Table 1 shows the systematic position of anopheline mosquitoes with specific and distinctive characters of phylum, class, subclass, order, division, suborder, family, subfamily, and genus. The mosquitoes of Toxorhynchitinae do not suck blood nor do they transmit any disease. The subfamilies Anophelinae and Culicinae are the ones which transmit disease.

The subfamily Anophelinae consists of Three genera — *Anopheles, Bironella*, and *Chagasia* — the subfamily Culicinae 33 genera, and Toxorhynchitinae only one genus. Worldwide there are over 3200 species of mosquitoes under 37 genera. In India the genera *Anopheles, Aedes, Mansonia*, and *Culex* are important inasmuch as they transmit malaria, dengue, filaria, and Japanese encephalitis. The genus *Anopheles* consists of about 420 species, of which 50 are well-known vectors of malaria. Table 2 gives the distribution of the anophelines in 12 epidemiological zones of the world. The subgenus *Anopheles* is found in all the 12 zones with a maximum distribution in Malaysian (56 species) and a minimum from Afrotropical zones (11 spp.). The subgenus *Cellia* is found in 10 zones, and a maximum number of species is recorded from Afrotropical zone (115 spp.) and a minimum from South American zone (1 sp. only). The subgenus *Kerteszia* is reported from only three American zones, with a maximum from South America (11 spp.), followed by Central America (5 spp.) and North America (1 sp. only). The subgenus *Lophopodomyia* is reported from two zones — South American (6 spp.) and Central American (1 sp. only). The subgenus *Nyssorhynchus* is reported only from four epidemiological zones with a maximum distribution in South America (30 spp.), followed by Central American (9 spp.), North American (4 spp.), and Chinese zone (1 sp.). The subgenus *Stethomyia* is reported from two regions only, South American (5 spp.) and Central American (2 spp.). Table 3 lists the countries with code numbers under 12 epidemiological zones of malaria to help locate the country in Fig. 1. In India, 58 species of anophelines are found, of which 6 are primary vectors — *An. culicifacies, An. stephensi, An. fluviatilis, An. dirus*,

An. sundaicus, and *An. minimus*—and 4 are secondary vectors, —*An. annularis*, *An. philippinensis*, *An. jeyporiensis* and *An. varuna*.

The genus *Anopheles* differs morphologically from other genera by virtue of an elongated slender palpus of length equal to that of the proboscis. Male palpi are club-shaped. Table 4 and Fig. 2 give the differences between the genera *Anopheles* and *Culex* in the egg, larva, pupa and adult stages. The diversity in characters and their ability to transmit the disease have prompted entomologists to conduct faunistic, ecological, vector incrimination and other studies.

Giles (1900, 1902) and Theobald (1901a, 1910) were the pioneers in the field of taxonomy and their contributions to mosquito systematics are unparalleled. Giles, in his book on *Gnats or Mosquitoes* published in 1900, gave the description of 242 species belonging to 8 genera: *Megarhinus* (18 spp.), *Anopheles* (30 spp.), *Psorophora* (3 spp.), *Sabethes* (3 spp.), *Culex* (160 spp.), *Aedes* (13 spp.), *Corethra* (12 spp.), and *Mochloynyx* (3 spp.). He grouped 20 species under continental Asia including three species under the genus *Megarhina*, six species under the genus *Anopheles*, and 11 species under the genus *Culex*. The anophelines listed were, *An. lindesayii* Giles, *An. rossii* Mittri, and *An. sinensis* Wied A and B.

In the second edition published in 1902, Giles described 252 species under 24 genera which included the redescribed species and new ones. A total of 47 species was described from India (excluding 2 spp. from Sri Lanka), of which 14 were anophelines which comprised 11 species and 3 subspecies, *Megarhina* (2 spp.), *Mucidus* (1 sp. only), *Stegomyia* (8 spp.), *Armigeres* (2 spp.), *Culex* (14 spp.), *Taeniorhynchus* (1 sp.), *Panoplites* (2 spp.), *Aedes* (1 sp.), *Aedeomyia* (1 sp.), and *Corethra* (1 sp.).

Of the anophelines the following species were described from India: *An. nigerrimus* Giles; *An. jamesii* Theobald; *An. sinensis* Wiedemann, (a) ssp. *An. fuliginosus* Giles, (b) ssp. *An. indiensis* Theobald and (c) ssp. *An. annularis* Van der Wulp; *An. barbirostris* Van der Wulp; *An. indicus* Theobald; *An. rossii* Giles; *An. lindesayi* Giles; *An. culicifacies* Giles; *An. gigas* sp.n.; *An. listoni* sp.n.; and *An. theobaldi* sp.n.

Theobald, in his monograph on the Culicidae published originally in 1901 (Vol. 1), grouped mosquitoes of the world under 22 genera, of which 9 were from India: —*Anopheles* (6 spp.), *Megarhinus* (2 spp.), *Stegomyia* (4 spp.), *Armigeres* (2 spp.), *Culex* (14 spp.), *Taeniorhynchus* (1 sp.), *Panoplites* (2 spp.), *Aedeomyia* (1 sp.) and *Corethra* (1 sp.).

Theobald published two more volumes in 1903 and 1907, in which he classified mosquitoes under 10 subfamilies: Anophelinae, Megarhiniae, Culicinae, Aedinae, Uranotaeninae, Deinoceratinae, Heptaphlebomyinae, Trichoprosoponinae, Dendromyinae and Limatinae. The subfamily Anophelinae contained 18 genera, the subfamily Culicinae 58, and the subfamily Aedinae 9 genera. Theobald (1907) described 107 species of anophelines under 16 genera. A supplement published in 1910 contained the description of 21 genera and 392 species of Culicidae of the world. The family Anophelinae consisted of 21 genera with 122 species (except the genus *Manguinhosia*).

Table 1: SYSTEMATIC POSITION OF ANOPHELINE MOSQUITOES

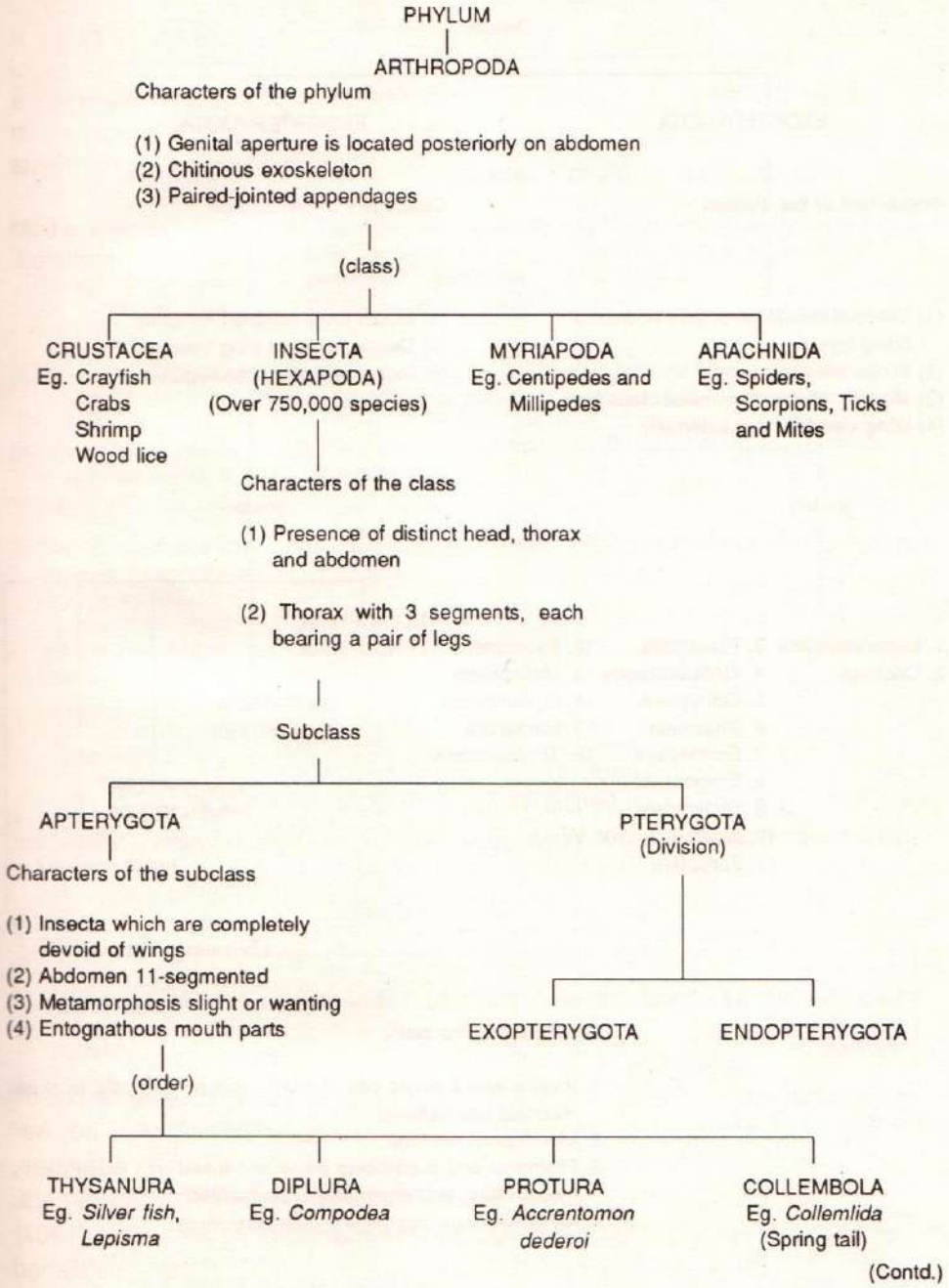

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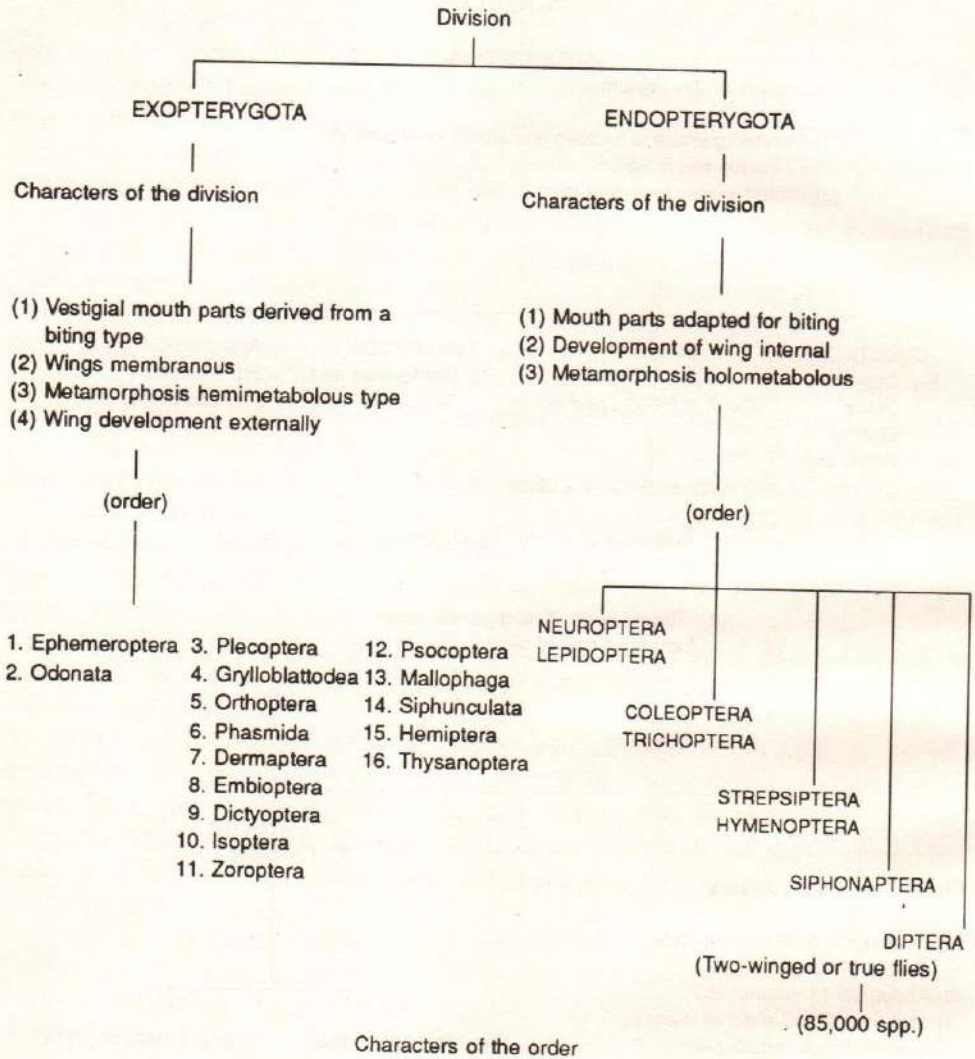
Table 1: Contd.



Characters of the order

1. Insects with a single pair of membranous wings, the hind pair modified into halteres
2. Mouth parts suctorial
3. Prothorax and metathorax small and fused with the large mesothorax; tarsi commonly 5-segmented
4. Metamorphosis complete (holometabolous)

(suborder)

NEMATOCERA — BRACHYCERA — CYCLORRHAPHA

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Table 1: Contd.

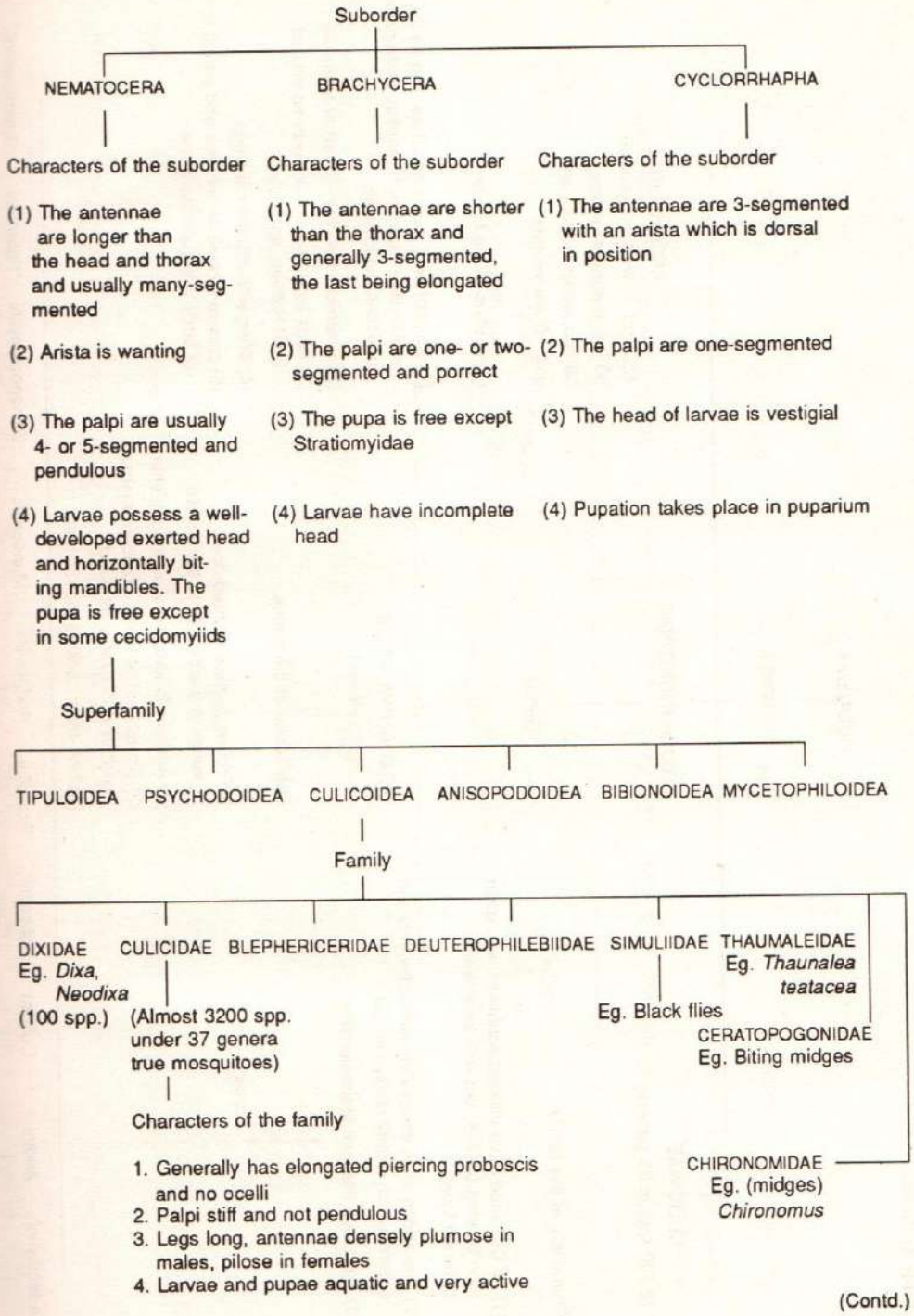

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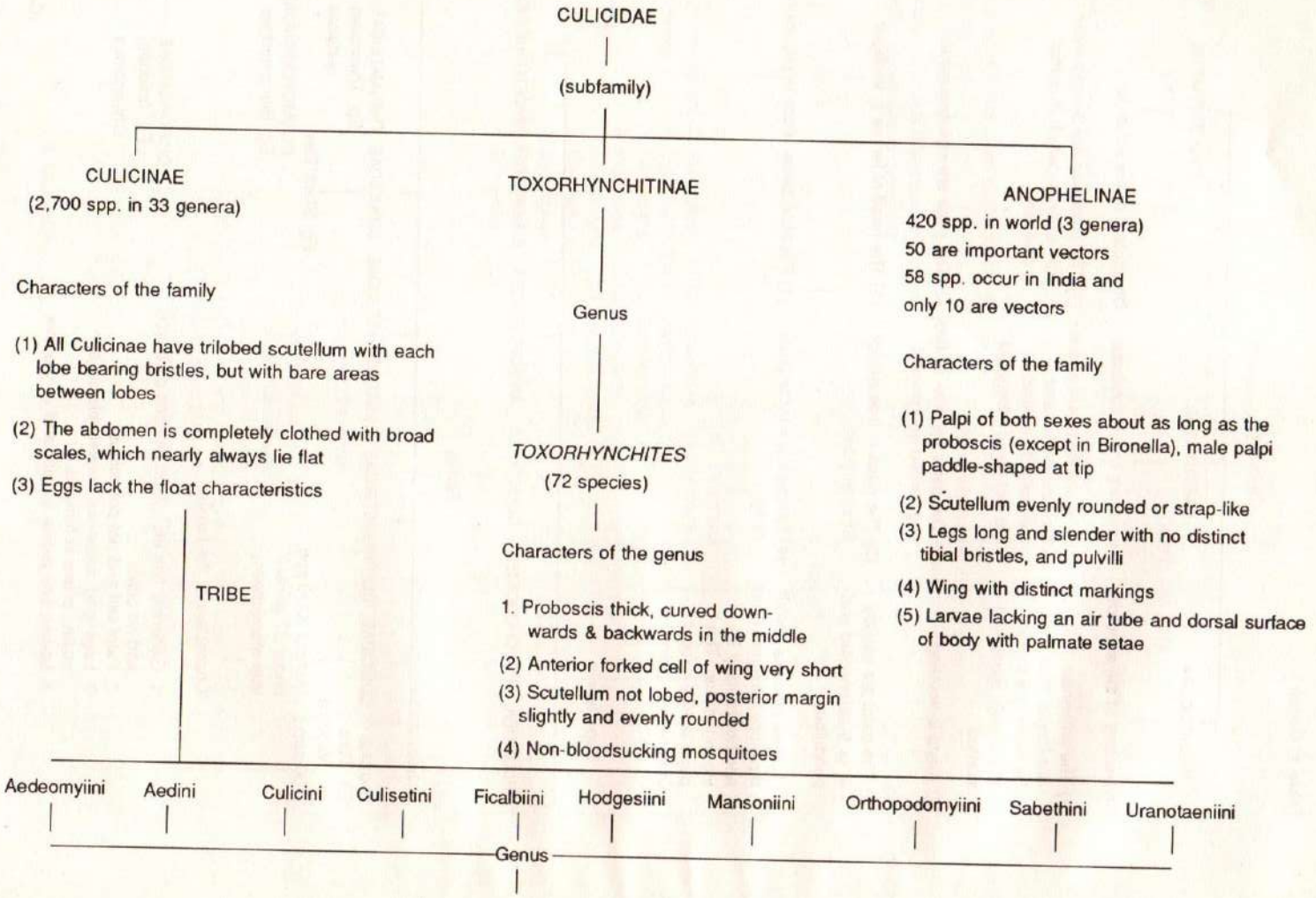
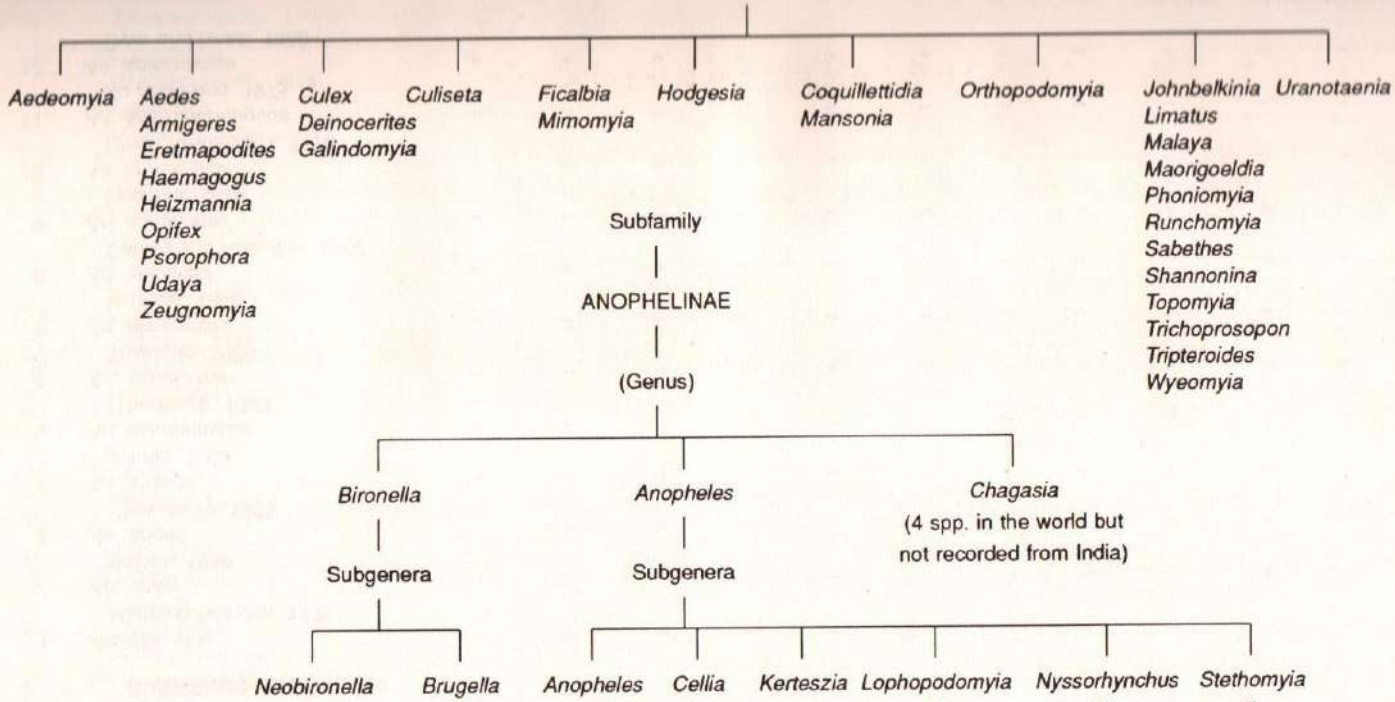
Table 1: Contd.





Species in each subgenus (Ward Personnel Communication)	2	3	173	197	11	6	31	5
Species reported from India (1993)	0	0	24	34	0	0	0	0

Table 2: WORLDWIDE DISTRIBUTION OF ANOPHELINES IN 12 DIFFERENT EPIDEMIOLOGICAL ZONES OF MALARIA

S.No.	GENUS *ANOPHELES*	North Ameri-can	Central Ameri-can	South Ameri-can	North Eura-sian	Medite-rranean	Desert	Afro-tropi-cal	Indo-Ira nian	Indo-Chinese Hills	Malay-sian	Chi-nese	Austra-lasian
	SUBGENUS *ANOPHELES*												
1.	*An. aberrans* Harrison Scanlon, 1975	–	–	–	–	–	–	–	–	+	–	–	–
2.	*An. acaci* Baisas, 1946	–	–	–	–	–	–	–	–	–	+	–	–
3.	*An. ahomi* Chowdhury, 1929	–	–	–	–	–	–	–	+	+	–	–	–
4.	*An. aitkenii* James, 1903	–	–	–	–	–	–	–	+	+	–	–	–
5.	*An. albotaeniatus* (Theobald), 1903	–	–	–	–	–	–	–	–	+	+	–	–
6.	*An. algeriensis* Theobald, 1903	–	–	–	+	+	+	–	+	–	–	–	–
7.	*An. alongensis* Venhuis, 1940	–	–	–	–	–	–	–	–	+	–	–	–
8.	*An. anchietai* Correa and Ramalho, 1968	–	–	+	–	–	–	–	–	–	–	–	–
9.	*An. annandalei* Prashad, 1918	–	–	–	–	–	–	–	+	+	+	–	–
10.	*An. annulipalpis* Lynch Arribalzaga, 1878	–	–	+	–	–	–	–	–	–	–	–	–
11.	*An. anthropophagous* Xu and Feng, 1975	–	–	–	–	–	–	–	–	–	–	+	–
12.	*An. apicimacula* Dyar and Knab, 1906	+	+	+	–	–	+	–	–	–	–	–	–

13.	*An. arboricola* Zavortink, 1970	–	+	–	–	–	–	–	–	–	–	–	–
14.	*An. argyropus* (Swellengrebel), 1914	–	–	–	–	–	–	–	+	+	+	–	–
15.	*An. asiaticus* Leicester, 1908	–	–	–	–	–	–	–	–	+	+	–	–
16.	*An. atratipes* Skuse, 1889	–	–	–	–	–	–	–	–	–	–	–	+
17.	*An. atroparvus* Van Theill, 1927	–	–	–	+	+	–	–	–	–	–	–	–
18.	*An. atropos* Dyar and Knab, 1906	+	+	–	–	–	–	–	–	–	–	–	–
19.	*An. aztecus* Hoffmann, 1935	+	–	–	–	–	–	–	–	+	+	–	–
20.	*An. baezai* Gater, 1933	–	–	–	–	–	–	–	–	+	+	–	–
21.	*An. baileyi* Edwards, 1929	–	–	–	–	–	–	–	+	+	–	+	–
22.	*An. balerensis* Mendoza, 1947	–	–	–	–	–	–	–	–	–	+	–	–
23.	*An. bancroftii* Giles, 1902	–	–	–	–	–	–	–	–	–	–	–	+
24.	*An. barberi* Coquillett, 1903	+	–	–	–	–	–	–	–	–	–	–	–
25.	*An. barbirostris* Van der Wulp, 1884	–	–	–	–	–	–	–	+	+	+	–	–
26.	*An. barbumbrosus* Strickland and Chowdhury, 1927	–	–	–	–	–	–	–	+	+	+	–	–

* Zones shown in figure and countries under each zone are given in Table.

(Contd.)

Table 2: Contd.

S.No.	GENUS *ANOPHELES*	North American	Central American	South American	North Eurasian	Mediterranean	Desert	Afrotropical	Indo-Iranian	Indo-Chinese Hills	Malaysian	Chinese	Australasian
27.	*An. barianensis* James, 1911	–	–	–	+	–	–	–	+	–	–	–	–
28.	*An. barianensis* James, 1911	–	–	–	+	–	–	–	–	–	–	–	–
29.	*An. bengalensis* Puri, 1930	–	–	–	–	–	–	–	+	+	+	+	–
30.	*An. bonnei* Da Fonseca and Da Silva Ramos, 1939	–	–	+	–	–	–	–	–	–	–	–	–
31.	*An. borneensis* McArthur, 1949	–	–	–	–	–	–	–	–	–	+	–	–
32.	*An. bradleyi* King, 1939	+	–	–	–	–	–	–	+	–	–	–	–
33.	*An. brevipalpis* Roper, 1914	–	–	–	–	–	–	–	–	–	+	–	–
34.	*An. brevirostris* Reid, 1950	–	–	–	–	–	–	–	–	–	+	–	–
35.	*An. bulkleyi* Causey, 1937	–	–	–	–	–	–	–	–	+	–	–	–
36.	*An. bustamentei* Galvao, 1955	–	–	+	–	–	–	–	–	–	–	–	–
37.	*An. calderoni* Wilkerson, 1991	–	–	+	–	–	–	–	–	–	–	–	–
38.	*An. caliginosus* De Meillon, 1943	–	–	–	–	–	–	+	–	–	–	–	–
39.	*An. campestris* Reid, 1962	–	–	–	–	–	–	–	–	+	+	–	–
40.	*An. chiriquierensis* Komp, 1936	–	+	–	–	–	–	–	–	–	–	–	–
41.	*An. chodukini* Martini, 1929	–	–	–	+	–	–	–	–	–	–	–	–

42.	*An. claviger* (Meigen), 1804	–	–	–	+	+	–	–	+	–	–	–	–
43.	*An. colledgei* Marks, 1956	–	–	–	–	–	–	–	–	–	–	–	+
44.	*An. collessi* Reid, 1963	–	–	–	–	–	–	–	–	–	+	–	+
45.	*An. concolor* Edwards, 1938	–	–	–	–	–	–	+	–	–	–	–	–
46.	*An. corethroides* Theobald, 1907	–	–	–	–	–	–	–	–	–	–	–	+
47.	*An. coustani* Laveran, 1900	–	–	–	–	+	+	+	–	–	–	–	–
48.	*An. crawfordi* Reid, 1953	–	–	–	–	–	–	–	–	+	+	–	–
49.	*An. crucians* Wiedemann, 1828	+	+	–	–	–	–	–	–	–	–	–	–
50.	*An. cucphuongensis* Phan Manh, Hinh and Vien, 1991	–	–	–	–	–	–	–	–	+	–	–	–
51.	*An. culiciformis* Cogill, 1903	–	–	–	–	–	–	–	+	–	–	–	–
52.	*An. donaldi* Reid, 1962	–	–	–	–	–	–	-	–	–	+	–	+
53.	*An. earlei* Vargas, 1943	+	–	–	–	–	–	–	–	–	–	–	–
54.	*An. eiseni* Coquillett, 1902	+	+	+	–	–	–	–	–	–	–	–	–
55.	*An. ejercitoi* Mendoza, 1947	–	–	–	–	–	–	–	–	–	+	–	–
56.	*An. engarensis* Kanda and Öguma, 1978	–	–	–	–	–	–	–	–	–	–	+	–
57.	*An. evandroi* Da Costa Lima, 1937	–	–	+	–	–	–	–	–	–	–	–	–

(Contd.)

Table 2: Contd.

S.No.	GENUS *ANOPHELES*	North American	Central American	South American	North Eurasian	Mediterranean	Desert	Afrotropical	Indo-Iranian	Indo-Chinese Hills	Malaysian	Chinese	Australasian
58.	*An. fausti* Vargas, 1943	+	–	–	–	–	–	–	–	–	–	–	–
59.	*An. fluminensis* Root, 1927	–	–	+	–	–	–	–	–	–	–	–	–
60.	*An. fragilis* (Theobald), 1903	–	–	–	–	–	–	–	–	+	+	–	–
61.	*An. franciscanus* McCracken, 1904	+	–	–	–	–	–	–	–	–	–	–	–
62.	*An. franciscoi* Reid, 1962	–	–	–	–	–	–	–	–	–	+	–	–
63.	*An. freeborni* Aitken, 1939	+	–	–	–	–	–	–	–	–	–	–	–
64.	*An. freyi* Meng, 1957	–	–	–	+	–	–	–	–	–	–	–	–
65.	*An. fuscicolor* Van Someren, 1947	–	–	–	–	–	–	+	–	–	–	–	–
66.	*An. gabaldoni* Vargas, 1941	+	+	–	–	–	–	–	–	–	–	–	–
67.	*An. georgianus* King, 1939	+	–	–	–	–	–	–	–	–	–	–	–
68.	*An. gigas* Giles, 1901	–	–	–	–	–	–	–	+	+	+	–	–
69.	*An. grabhamii* Theobald, 1901	–	+	–	–	–	–	–	–	–	–	–	–
70.	*An. guarao* Anduze and Capdevielle, 1949	–	–	+	–	–	–	–	–	–	–	–	–
71.	*An. habibi* Mulligan and Puri, 1936	–	–	–	–	–	–	–	+	–	–	–	–
72.	*An. hectoris* Giaquinto-Mira, 1931	+	+	–	–	–	–	–	–	–	–	–	–

73.	*An. heiheensis* Ma, 1981	–	–	–	–	–	–	–	–	–	–	+	–
74.	*An. hermsi* Barr and Guptavanij, 1988	+	–	–	–	–	–	–	–	–	–	–	–
75.	*An. hodgkini* Reid, 1962	–	–	–	–	–	–	–	–	+	+	–	–
76.	*An. hunteri* (Strickland), 1916	–	–	–	–	–	–	–	–	–	+	–	–
77.	*An. hyrcanus* (Pallas), 1771	–	–	–	–	+	+	–	+	–	–	+	–
78.	*An. implexus* (Theobald), 1903	–	–	–	–	–	–	+	–	–	–	–	–
79.	*An. insulaeflorum* (Swellengrebel and Swellengrebel de Graaf), 1919	–	–	–	–	–	–	–	+	+	+	–	–
80.	*An. intermedius* (Peryassu), 1908	–	–	+	–	–	–	–	–	–	–	–	–
81.	*An. interruptus* Puri, 1929	–	–	–	–	–	–	–	+	+	+	+	–
82.	*An. judithae* Zavortink, 1969	+	–	–	–	–	–	–	–	–	–	–	–
83.	*An. kiangsuensis* Xu and Feng, 1975	–	–	–	–	–	–	–	–	–	–	+	–
84.	*An. koreicus* Yamada and Watanabe, 1918	–	–	–	–	–	–	–	–	–	–	+	–
85.	*An. kunmingensis* Dong and Wang, 1985	–	–	–	–	–	–	–	–	–	+	–	–
86.	*An. kweiyangensis* Yao and Wu, 1944	–	–	–	+	–	–	–	–	–	–	–	–
87.	*An. kyondawensis* Abraham, 1947	–	–	–	–	–	–	–	–	+	–	–	–
88.	*An. labranchiae* Falleroni, 1926	–	–	–	–	+	+	–	–	–	–	–	–

(Contd.)

Table 2: Contd.

S.No.	GENUS *ANOPHELES*	North American	Central American	South American	North Eurasian	Mediterranean	Desert	Afrotropical	Indo-Iranian	Indo-Chinese Hills	Malaysian	Chinese	Australasian
89.	*An. lesteri* Baisas and Hu, 1936	–	–	–	–	–	–	–	–	–	+	+	–
90.	*An. letifer* Sandosham, 1944	–	–	–	–	–	–	–	–	+	+	–	–
91.	*An. lewisi* Ludlow, 1920	–	–	–	+	–	–	–	–	–	–	–	–
92.	*An. liangshanensis* Kang, Tan, Chen Yeng and Huang, 1984	–	–	–	–	–	–	–	–	–	–	+	–
93.	*An. lindesayi* Giles, 1900	–	–	–	+	–	–	–	+	+	+	+	–
94.	*An. maculipennis* Meigen, 1818	–	–	–	+	+	–	–	+	–	–	–	–
95.	*An. maculipes* (Theobald), 1903	–	–	+	–	–	–	–	–	–	–	–	–
96.	*An. manalangi* Mendoza, 1940	–	–	–	–	–	–	–	–	–	+	–	–
97.	*An. marteri* Senevet and Prunnelle, 1927	–	–	–	+	+	+	–	–	–	–	–	–
98.	*An. martinius* (Shingarev), 1926	–	–	–	+	–	–	–	–	–	–	–	–
99.	*An. mattogrossensis* Lutz and Neiva, 1911	–	–	+	–	–	–	–	–	–	–	–	–
100.	*An. mediopunctatus* (Theobald), 1903	–	+	+	–	–	–	–	–	–	–	–	–
101.	*An. melanoon* Hacket, 1934	–	–	–	+	+	–	–	+	–	–	–	–
102.	*An. mengalangensis* Ma, 1981	–	–	–	–	+	–	–	–	–	–	+	–
103.	*An. messeae* Falleroni, 1926	–	–	–	+	–	+	–	–	–	–	–	–

104.	*An. minor* Da Costa Lima, 1929	–	–	+	–	–	–	–	–	–	–	–	–
105.	*An. montanus* Stanton and Hacker, 1917	–	–	–	–	–	–	–	–	+	+	–	+
106.	*An. nambiensis* Coetzee, 1984	–	–	–	–	–	–	+	–	–	–	–	–
107.	*An. neomaculipalpus* Curry, 1931	+	+	+	–	–	–	–	–	–	–	–	–
108.	*An. nigerrimus* Giles, 1900	–	–	–	+	–	–	–	+	+	+	–	+
109.	*An. nilgericus* Christophers, 1924	–	–	–	–	–	–	–	+	–	–	–	–
110.	*An. nitidus* Harrison, Scanlon and Reid, 1973	–	–	–	–	–	–	–	–	+	+	–	–
111.	*An. noniae* Reid, 1963	–	–	–	–	–	–	–	–	–	+	–	–
112.	*An. obscurus* (Gruenberg), 1905	–	–	–	–	–	+	+	–	–	–	–	–
113.	*An. occidentalis* Dyar and Knab, 1906	+	–	–	–	–	–	–	–	–	–	–	–
114.	*An. omorii* Sakakibara, 1959	–	–	–	–	–	–	–	–	–	–	+	–
115.	*An. palmatus* (Rodenwaldt), 1926	–	–	–	–	–	–	–	–	+	+	–	+
116.	*An. paludis* Theobald, 1900	–	–	–	–	–	+	+	–	–	–	–	–
117.	*An. papuensis* Dobrotworsky, 1957	–	–	–	–	–	–	–	–	+	+	–	–
118.	*An. paraliae* Sndoshom, 1959	–	–	–	–	–	–	–	–	+	+	–	–
119.	*An. parapunctipennis* Martini, 1932	+	+	–	–	–	–	–	–	–	–	–	–

(Contd.)

Table 2: Contd.

S.No.	GENUS *ANOPHELES*	North American	Central American	South American	North Eurasian	Mediterranean	Desert	Afrotropical	Indo-Iranian	Indo-Chinese Hills	Malaysian	Chinese	Australasian
120.	*An. peditaeniatus* (Leicester), 1908	–	–	–	–	–	–	–	+	+	+	–	–
121.	*An. perplexens* Ludlow, 1907	+	–	–	–	–	–	–	–	–	–	–	–
122.	*An. peryassui* Dyar and Knab, 1908	–	–	+	–	–	–	–	–	–	–	–	–
123.	*An. petragnani* Del Vecchio, 1939	–	–	–	–	+	–	–	–	–	–	–	–
124.	*An. peytoni* Kulasekera, Harrison & Amerasinghe, 1988	–	–	–	–	–	–	–	+	–	–	–	–
125.	*An. pilinotum* Barraud, 1932	–	–	–	–	–	–	–	–	–	+	–	–
126.	*An. pinjaurensis* Barraud, 1932	–	–	–	–	–	–	–	+	–	–	–	–
127.	*An. plumbeus* Stephens, 1828	–	–	–	+	+	+	–	+	–	–	–	–
128.	*An. pollicaris* Reid, 1962	–	–	–	–	–	–	–	–	+	+	–	–
129.	*An. powderi* Zavortink, 1970	–	+	–	–	–	–	–	–	–	–	–	–
130.	*An. powelli* Lee, 1944	–	–	–	–	–	–	–	–	–	–	–	+
131.	*An. pseudobarbirostris* Ludlow, 1902	–	–	–	–	–	–	–	–	+	+	–	+
132.	*An. pseudomaculipes* (Peryassu), 1908	–	–	+	–	–	–	–	–	–	–	–	–
133.	*An. pseudopunctipennis* Theobald, 1901	+	+	+	–	–	–	–	–	–	–	–	–

134.	*An. pseudosinensis* Baisas, 1935	–	–	–	–	–	–	–	–	–	+	–	–
135.	*An. pseudostigmaticus* Dobrotworsky, 1957	–	–	–	–	–	–	–	–	–	–	–	+
136.	*An. pullus* Yamada, 1937	–	–	–	–	–	–	–	–	–	–	+	–
137.	*An. punctimacula* Dyar and Ḱnab, 1906	+	+	+	–	–	–	–	–	–	–	–	–
138.	*An. punctipennis* (Say), 1823	+	–	–	–	–	–	–	–	–	–	–	–
139.	*An. pursati* Laveran, 1902	–	–	–	–	–	–	–	–	+	+	–	–
140.	*An. quadrimaculatus* Say, 1824	+	–	–	–	–	–	–	–	–	–	–	–
141.	*An. rachoui* Galvao, 1952	–	–	+	–	–	–	–	–	–	–	–	–
142.	*An. reidi* Harrison, 1973	–	–	–	–	–	–	–	+	–	–	–	–
143.	*An. roperi* Reid, 1950	–	–	–	–	–	–	–	–	+	+	–	–
144.	*An. sacharovi* Favre, 1903	–	–	–	+	+	+	–	+	–	–	–	–
145.	*An. samarensis* Rozeboom, 1951	–	–	–	–	–	–	–	–	–	+	–	–
146.	*An. saperoi* Bohart and Ingram, 1946	–	–	–	–	–	–	–	–	–	–	+	–
147.	*An. separatus* (Leicester), 1908	–	–	–	–	–	–	–	–	+	+	–	–
148.	*An. shannoni* Davis, 1931	–	–	+	–	–	–	–	–	–	–	–	–
149.	*An. sicaulti* Roubaud, 1935	–	–	–	–	+	–	–	–	–	–	–	–

(Contd.)

Table 2: Contd.

S.No.	GENUS *ANOPHELES*	North Ameri-can	Central Ameri-can	South Ameri-can	North Eura-sian	Medite-rranean	Desert	Afro-tropi-cal	Indo-Ira-nian	Indo-Chinese Hills	Malay-sian	Chi-nese	Austral-asian
150.	*An. similissimus* Strickland and Chowdhury, 1927	–	–	–	–	–	–	–	–	–	+	–	–
151.	*An. sinensis* Wiedemann, 1828	–	–	–	+	–	–	–	+	+	+	+	–
152.	*An. sineroides* Yamada, 1924	–	–	–	–	–	–	–	–	–	–	+	–
153.	*An. sintoni* Puri, 1929	–	–	–	–	–	–	–	+	–	–	–	–
154.	*An. sintonoides* Ho, 1938	–	–	–	–	–	–	–	–	+	+	+	–
155.	*An. subalpinus* Hackett and Lewis, 1935	–	–	–	+	+	–	–	–	–	–	–	–
156.	*An. stigmaticus* Skuse, 1889	–	–	–	–	–	–	–	–	–	+	–	+
157.	*An. stricklandi* Reid, 1965	–	–	–	–	–	–	–	–	+	+	–	–
158.	*An. symesi* Edwards, 1928	–	–	–	–	–	–	+	–	–	–	–	–
159.	*An. tasmaniensis* Dobrotworsky, 1966	–	–	–	–	–	–	–	–	–	–	–	+
160.	*An. tenebrosus* Doenitz, 1902	–	–	–	–	–	+	+	–	–	–	–	–
161.	*An. tibiamaculatus* (Neiva), 1906	–	–	+	–	–	–	–	–	–	–	–	–
162.	*An. tigertti* Scanlon and Peyton, 1967	–	–	–	–	–	–	–	–	+	–	–	–
163.	*An. umbrosus* (Theobald), 1903	–	–	–	–	–	–	–	+	+	+	–	–
164.	*An. vanus* Walker, 1859	–	–	–	–	–	–	–	–	–	+	–	–

165.	*An. veruslanei* Vargas, 1979	+	–	–	–	–	–	–	–	–	–	–	–
166.	*An. vestitipennis* Dyar and Knab, 1906	+	+	+	–	–	–	–	–	–	–	–	–
167.	*An. walkeri* Theobald, 1901	+	–	–	–	–	–	–	–	–	–	–	–
168.	*An. wellingtonianus* Alcock, 1912	–	–	–	–	–	–	–	–	–	+	–	–
169.	*An. whartoni* Reid, 1963	–	–	–	–	–	–	–	–	+	+	–	–
170.	*An. xiakuanus* Ma, 1981	–	–	–	–	–	–	–	–	–	–	+	–
171.	*An. xelajuensis* De Leon, 1938	+	+	–	–	–	–	–	–	–	–	–	–
172.	*An. yatsushiroensis* Miyazaki, 1951	–	–	–	–	–	–	–	–	–	–	+	–
173.	*An. ziemanni* Greunberg, 1902	–	–	–	–	–	+	+	–	–	–	–	–
	SUBGENUS *CELLIA*												
174.	*An. aconitus* Doenitz, 1902	–	–	–	–	–	–	–	+	+	+	–	+
175.	*An. amictus* Edwards, 1921	–	–	–	–	–	–	–	–	–	–	–	+
176.	*An. annularis* Van der Wulp, 1884	–	–	–	–	–	–	–	+	+	+	–	+
177.	*An. annulatus* De Rook, 1929	–	–	–	–	–	–	–	–	–	+	–	+
178.	*An. annulipes* Walker, 1856	–	–	–	–	–	–	–	–	–	+	–	+
179.	*An. apoci* Marsh, 1933	–	–	–	–	–	–	–	+	–	–	–	–

(Contd.)

Table 2: Contd.

S.No.	GENUS *ANOPHELES*	North American	Central American	South American	North Eurasian	Mediterranean	Desert	Afrotropical	Indo-Iranian	Indo-Chinese Hills	Malaysian	Chinese	Australasian
180.	*An. arabiensis* (Patton), 1905	–	–	–	–	–	+	+	–	–	–	–	–
181.	*An. ardensis* (Theobald), 1905	–	–	–	–	–	–	+	–	–	–	–	–
182.	*An. argenteolobatus* (Gough), 1910	–	–	–	–	–	–	+	–	–	–	–	–
183.	*An. arnoulti* Grjebine, 1966	–	–	–	–	–	–	+	–	–	–	–	–
184.	*An. aruni* Sobti, 1968	–	–	–	–	–	–	+	–	–	–	–	–
185.	*An. aurirostris* (Watson), 1910	–	–	–	–	–	–	–	–	–	+	–	–
186.	*An. austenii* (Theobald), 1905	–	–	–	–	–	–	+	–	–	–	–	–
187.	*An. azaniae* Bailly-Choumara, 1960	–	–	–	–	–	–	+	–	–	–	–	–
188.	*An. azevedoi* Ribeiro, 1969	–	–	–	–	–	–	+	–	–	–	–	–
189.	*An. balabacensis* Baisas, 1936	–	–	–	–	–	–	–	+	+	+	–	–
190.	*An. barberellus* Evans, 1932	–	–	–	–	–	+	+	–	–	–	–	–
191.	*An. berghei* Vincke and Leleup, 1949	–	–	–	–	–	–	+	–	–	–	–	–
192.	*An. bervoetsi* D'Haenans, 1961	–	–	–	–	–	–	+	–	–	–	–	–
193.	*An. brohieri* Edwards, 1929	–	–	–	–	–	–	+	–	–	–	–	–
194.	*An. brucei* Service, 1960	–	–	–	–	–	–	+	–	–	–	–	–

195.	*An. brumpti* Hamon and Rickenbach, 1955	–	–	–	–	–	–	+	–	–	–	–	–
196.	*An. brunnipes* (Theobald), 1910	–	–	–	–	–	–	+	–	–	–	–	–
197.	*An. buxtoni* Service, 1958	–	–	–	–	–	–	+	–	–	–	–	–
198.	*An. bwambae* White, 1985	–	–	–	–	–	–	+	–	–	–	–	–
199.	*An. cameroni* De Meillon and Evans, 1935	–	–	–	–	–	–	+	–	–	–	–	–
200.	*An. caroni* Adam, 1961	–	–	–	–	–	–	+	–	–	–	–	–
201.	*An. carteri* Evans and De Meillon, 1933	–	–	–	–	–	–	+	–	–	–	–	–
202.	*An. christyi* (Newstead and Carter), 1911	–	–	–	–	–	–	+	–	–	–	–	–
203.	*An. cinctus* (Newstead and Carter), 1910	–	–	–	–	–	–	+	–	–	–	–	–
204.	*An. cinereus* Theobald, 1901	–	–	–	–	–	+	+	–	–	–	–	–
205.	*An. clowi* Rozeboom and Knight, 1946	–	–	–	–	–	–	–	–	–	–	–	+
206.	*An. confusus* Evans and Lesson, 1935	–	–	–	–	–	–	+	–	–	–	–	–
207.	*An. cordurieri* Grjebine, 1966	–	–	–	–	–	–	+	–	–	–	–	–
208.	*An. cristatus* King and Baisas, 1936	–	–	–	–	–	–	–	–	–	+	–	+
209.	*An. cristipalpis* Service, 1977	–	–	–	–	–	–	+	–	–	–	–	–
210.	*An. culicifacies* Giles, 1901	–	–	–	+	–	+	–	+	+	+	+	–
211.	*An. cydippis* De Meillon, 1931	–	–	–	–	–	–	+	–	–	–	–	–

(Contd.)

Table 2: Contd.

S.No.	GENUS *ANOPHELES*	North American	Central American	South American	North Eurasian	Mediterranean	Desert	Afrotropical	Indo-Iranian	Indo-Chinese Hills	Malaysian	Chinese	Australasian
212.	*An. dancalicus* Corradetti, 1939	–	–	–	–	–	–	+	–	–	–	–	–
213.	*An. daudi* Coluzzi, 1958	–	–	–	–	–	–	+	–	–	–	–	–
214.	*An. deemingi* Service, 1970	–	–	–	–	–	–	+	–	–	–	–	–
215.	*An. demeilloni* Evans, 1933	–	–	–	–	–	–	+	–	–	–	–	–
216.	*An. dirus* Peyton and Harrison, 1979	–	–	–	–	–	–	–	–	+	–	–	–
217.	*An. dispar* Rattanarithikul and Harbach, 1991	–	–	–	–	–	–	–	–	–	+	–	–
218.	*An. distinctus* (Newstead and Carter), 1911	–	–	–	–	–	–	+	–	–	–	–	–
219.	*An. domicola* Edwards, 1916	–	–	–	–	–	–	+	–	–	–	–	–
220.	*An. draviedicus* Christophers, 1924	–	–	–	–	–	–	–	–	+	+	–	–
221.	*An. dthali* Patton, 1905	–	–	–	–	–	+	+	+	–	–	–	–
222.	*An. dureni* Edwards, 1938	–	–	–	–	–	–	+	–	–	–	–	–
223.	*An. elegans* (James), 1903	–	–	–	–	–	–	–	+	–	–	–	–
224.	*An. erythraeus* Corradetti, 1939	–	–	–	–	–	–	+	–	–	–	–	–
225.	*An. erepens* Gillies and Coetzee, 1987	–	–	–	–	–	–	+	–	–	–	–	–
226.	*An. ethiopicus* Gillies and Coetzee, 1987	–	–	–	–	–	–	+	–	–	–	–	–

227.	*An. faini* Leleup, 1952	–	–	–	–	–	–	+	–	–	–	–	–
228.	*An. farauti* Laveran, 1902	–	–	–	–	–	–	–	–	–	+	–	+
229.	*An. filipinae* Manalang, 1930	–	–	–	–	–	–	–	–	+	+	–	–
230.	*An. flavicosta* Edwards, 1911	–	–	–	–	–	–	+	–	–	–	–	–
231.	*An. flavirostris* (Ludlow), 1914	–	–	–	–	–	–	–	–	–	+	–	+
232.	*An. fluviatilis* James, 1902	–	–	–	+	–	+	–	+	+	+	+	–
233.	*An. fontinalis* Gillies and De Meillon, 1968	–	–	–	–	–	–	+	–	–	–	–	–
234.	*An. freetownensis* Evans, 1925	–	–	–	–	–	–	+	–	–	–	–	–
235.	*An. funestus* Giles, 1900	–	–	–	–	–	–	+	–	–	–	–	–
236.	*An. fuscivenosus* Leeson, 1930	–	–	–	–	–	–	+	–	–	–	–	–
237.	*An. gambiae* Giles, 1902	–	–	–	–	–	–	+	–	–	–	–	–
238.	*An. garnhami* Edwards, 1930	–	–	–	–	–	–	+	–	–	–	–	–
239.	*An. gibbinsi* Evans, 1935	–	–	–	–	–	–	+	–	–	–	–	–
240.	*An. grassei* Grjebine, 1953	–	–	–	–	–	–	+	–	–	–	–	–
241.	*An. grenieri* Grjebine, 1964	–	–	–	–	–	–	+	–	–	–	–	–
242.	*An. greeni* Rattanarithikul and Harbach, 1991	–	–	–	–	–	–	–	–	–	+	–	–

(Contd.)

Table 2: Contd.

S.No.	GENUS *ANOPHELES*	North American	Central American	South American	North Eurasian	Mediterranean	Desert	Afrotropical	Indo-Iranian	Indo-Chinese Hills	Malaysian	Chinese	Australasian
243.	*An. griveaudi* Grjebine, 1960	–	–	–	–	–	–	+	–	–	–	–	–
244.	*An. hackeri* Edwards, 1921	–	–	–	–	–	–	–	–	+	+	–	–
245.	*An. hamoni* Adam, 1962	–	–	–	–	–	–	+	–	–	–	–	–
246.	*An. hancocki* Edwards, 1929	–	–	–	–	–	–	+	–	–	–	–	–
247.	*An. hargreavesi* Evans, 1927	–	–	–	–	–	+	+	–	–	–	–	–
248.	*An. harperi* Evans, 1936	–	–	–	–	–	–	+	–	–	–	–	–
249.	*An. hilly* Woodhill and Lee, 1944	–	–	–	–	–	–	–	–	–	–	–	+
250.	*An. hughi* Lambert and Coetzee, 1982	–	–	–	–	–	–	+	–	–	–	–	–
251.	*An. incognitus* Brug, 1931	–	–	–	–	–	–	–	–	–	–	–	+
252.	*An. indefinitus* (Ludlow), 1904	–	–	–	–	–	–	–	–	+	+	+	–
253.	*An. introlatus* Colless, 1957	–	–	–	–	–	–	–	–	–	+	–	–
254.	*An. jamesii* Theobald, 1901	–	–	–	–	–	–	–	+	+	+	+	–
255.	*An. jebudensis* Froud, 1944	–	–	–	–	–	–	+	–	–	–	–	–
256.	*An. jeyporiensis* James, 1902	–	–	–	–	–	–	–	+	+	+	–	–
257.	*An. karwari* (James), 1902	–	–	–	–	–	–	–	+	+	+	–	+

258.	*An. keniensis* Evans, 1931	–	–	–	–	–	–	+	–	–	–	–	–
259.	*An. kingi* Christophers, 1923	–	–	–	–	–	–	+	–	–	–	–	–
260.	*An. kochi* Doenitz, 1901	–	–	–	–	–	–	–	+	+	+	–	+
261.	*An. kolambuganensis* Baisas, 1932	–	–	–	–	–	–	–	–	–	+	–	–
262.	*An. koliensis* Owen, 1945	–	–	–	–	–	–	–	–	–	+	–	+
263.	*An. kosiensis* Coetzee, Segerman and Hunt, 1987	–	–	–	–	–	–	+	–	–	–	–	+
264.	*An. lacani* Grjebine, 1953	–	–	–	–	–	–	+	–	–	–	–	–
265.	*An. latabensis* Lambert and Coetzee, 1982	–	–	–	–	–	–	+	–	–	–	–	–
266.	*An. leesoni* Evans, 1931	–	–	–	–	–	–	+	–	–	–	–	–
267.	*An. leucosphyrus* Doenitz, 1901	–	–	–	–	–	–	–	–	–	+	–	–
268.	*An. limosus* King, 1932	–	–	–	–	–	–	–	–	–	+	–	–
269.	*An. listeri* De Meillon, 1931	–	–	–	–	–	–	+	–	–	–	–	–
270.	*An. litoralis* King, 1932	–	–	–	–	–	–	–	–	–	+	–	–
271.	*An. lloreti* Gil Collado, 1936	–	–	–	–	–	–	+	–	–	–	–	–
272.	*An. longipalpis* (Theobald), 1903	–	–	–	–	–	–	+	–	–	–	–	–
273.	*An. longirostris* Brug, 1928	–	–	–	–	–	–	–	–	–	+	–	+
274.	*An. lounibosci* Gillies and Coetzee, 1987	–	–	–	–	–	–	+	–	–	–	–	–

(Contd.)

Table 2: Contd.

S.No.	GENUS *ANOPHELES*	North American	Central American	South American	North Eurasian	Mediterranean	Desert	Afrotropical	Indo-Iranian	Indo-Chinese Hills	Malaysian	Chinese	Australasian
275.	*An. lovettae* Evans, 1934	–	–	–	–	–	–	–	–	–	+	–	–
276.	*An. ludlowae* (Theobald), 1903	–	–	–	–	–	–	–	–	–	+	–	–
277.	*An. lungae* Belkin and Schlosser, 1944	–	–	–	–	–	–	–	–	–	+	–	–
278.	*An. macarthuri* Colless, 1956	–	–	–	–	–	–	–	–	–	+	–	–
279.	*An. machardyi* Edwards, 1930	–	–	–	–	–	–	+	–	–	–	–	–
280.	*An. maculatus* Theobald, 1901	–	–	–	–	–	–	–	+	+	+	–	–
281.	*An. maculipalpis* Giles, 1902	–	–	–	–	–	–	+	–	–	–	–	–
282.	*An. majidi* Young and Majid, 1928	–	–	–	–	–	–	–	+	+	–	–	–
283.	*An. maliensis* Bailly-Choumara and Adam, 1959	–	–	–	–	–	–	+	–	–	–	–	–
284.	*An. mangyanus* (Banks), 1906	–	–	–	–	–	–	–	–	–	+	–	–
285.	*An. marajoara* (Galvao and Lane), 1942	–	–	+	–	–	–	–	–	–	–	–	–
286.	*An. marshallii* (Theobald), 1903	–	–	–	–	–	–	+	–	–	–	–	–
287.	*An. mascarensis* De Meillon, 1947	–	–	–	–	–	–	+	–	–	–	–	–
288.	*An. melas* Theobald, 1903	–	–	–	–	–	–	+	–	–	–	–	–
289.	*An. meraukensis* Venhuis, 1932	–	–	–	–	–	–	–	–	–	+	–	+

290.	*An. merus* Doenitz, 1902	–	–	–	–	–	–	+	–	–	–	–	–
291.	*An. milloti* Grjebine and Lacan, 1953	–	–	–	–	–	–	+	–	–	–	–	–
292.	*An. minimus* Theobald, 1901	–	–	–	–	–	–	–	+	+	+	+	–
293.	*An. moghulensis* Christophers, 1924	–	–	–	+	–	–	–	+	–	–	–	–
294.	*An. mortiauxi* Edwards, 1938	–	–	–	–	–	–	+	–	–	–	–	–
295.	*An. moucheti* Evans, 1925	–	–	–	–	–	–	+	–	–	–	–	–
296.	*An. mousinhoi* De Meillon and Pereira, 1940	–	–	–	–	–	–	+	–	–	–	–	–
297.	*An. multicolor* Cambouliu, 1902	–	–	–	–	+	+	–	+	–	–	–	–
298.	*An. murphyi* Gillies and De Meillon, 1968	–	–	–	–	–	–	+	–	–	–	–	–
299.	*An. natalensis* (Hill and Haydon), 1907	–	–	–	–	–	–	+	–	–	–	–	–
300.	*An. nataliae* Belkin, 1945	–	–	–	–	–	–	–	–	–	–	–	+
301.	*An. negros* Colless, 1956	–	–	–	–	–	–	–	–	–	+	–	–
302.	*An. nemophilous* Peyton and Ramalingam, 1988	–	–	–	–	–	–	–	–	–	+	–	–
303.	*An. nili* (Theobald), 1904	–	–	–	–	–	–	+	–	–	–	–	–
304.	*An. nivipes* (Theobald), 1903	–	–	–	–	–	–	–	–	+	+	–	–
305.	*An. njombiensis* Peters, 1955	–	–	–	–	–	–	+	–	–	–	–	–

(Contd.)

Table 2: Contd.

S.No.	GENUS *ANOPHELES*	North American	Central American	South American	North Eurasian	Mediterranean	Desert	Afrotropical	Indo-Iranian	Indo-Chinese Hills	Malaysian	Chinese	Australasian
306.	*An. notanandai* Rattanrithikul and Green, 1986	–	–	–	–	–	–	–	–	–	+	–	–
307.	*An. notleyi* Van Someran, 1949	–	–	–	–	–	–	+	–	–	–	–	–
308.	*An. novaguinensis* Venhuis, 1933	–	–	–	–	–	–	–	–	–	–	–	+
309.	*An. pallidus* Theobald, 1901	–	–	–	–	–	–	–	+	+	+	–	–
310.	*An. paltrinierii* Shidrawi and Gillies, 1987	–	–	–	–	–	–	–	+	–	–	–	–
311.	*An. pampanai* Buettiker and Beales, 1959	–	–	–	–	–	–	–	–	+	–	–	–
312.	*An. parangensis* (Ludlow), 1914	–	–	–	–	–	–	–	–	–	+	–	–
313.	*An. parensis* Gillies, 1962	–	–	–	–	–	–	+	–	–	–	+	–
314.	*An. pattoni* Christophers, 1926	–	–	–	–	–	–	–	–	–	–	+	–
315.	*An. pauliani* Grjebine, 1953	–	–	–	–	–	–	+	–	–	–	–	–
316.	*An. pharoensis* Theobald, 1901	–	–	–	–	+	+	+	–	–	–	–	–
317.	*An. philippinensis* Ludlow, 1902	–	–	–	–	–	–	–	+	+	+	+	–
318.	*An. pretoriensis* (Theobald), 1903	–	–	–	–	–	–	+	–	–	–	–	–
319.	*An. pseudojamesi* Strickland and Chowdhury, 1927	–	–	–	–	–	–	+	–	–	–	–	+
320.	*An. pseudowillmori* (Theobald), 1910	–	–	–	–	–	–	–	+	+	+	–	–

321.	*An. pujutensis* Colless, 1948	–	–	–	–	–	–	–	–	+	+	–	–
322.	*An. pulcherrimus* Theobald, 1902	–	–	–	+	+	+	–	+	+	–	–	–
323.	*An. punctulatus* Doenitz, 1901	–	–	–	–	–	–	–	–	–	–	–	+
324.	*An. quadriannulatus* (Theobald), 1911	–	–	–	–	–	–	+	–	–	–	–	–
325.	*An. radama* De Meillon, 1943	–	–	–	–	–	–	+	–	–	–	–	–
326.	*An. ranci* Grjebine, 1953	–	–	–	–	–	–	+	–	–	–	–	–
327.	*An. rhodesiensis* Theobald, 1901	–	–	–	–	–	+	+	–	–	–	–	–
328.	*An. riparis* King and Baisas, 1936	–	–	–	–	–	–	–	–	–	+	–	–
329.	*An. rivulorum* Leeson, 1935	–	–	–	–	–	–	+	–	–	–	–	–
330.	*An. rodhaini* Leleup and Lips, 1950	–	–	–	–	–	–	+	–	–	–	–	–
331.	*An. roubaudi* Grjebine, 1953	–	–	–	–	–	–	+	–	–	–	–	–
332.	*An. ruarinus* Edwards, 1940	–	–	–	–	–	–	+	–	–	–	–	–
333.	*An. rufipes* (Gough), 1910	–	–	–	–	–	–	+	–	–	–	–	–
334.	*An. salbaii* Maffi and Coluzzi, 1958	–	–	–	–	–	–	+	–	–	–	–	–
335.	*An. saungi* Colless, 1955	–	–	–	–	–	–	–	–	–	+	–	–

(Contd.)

Table 2: Contd.

S.No.	GENUS *ANOPHELES*	North American	Central American	South American	North Eurasian	Mediterranean	Desert	Afrotropical	Indo-Iranian	Indo-Chinese Hills	Malaysian	Chinese	Australasian
336.	*An. sawadwongporni* Rattananarithikul and Green, 1986	–	–	–	–	–	–	–	–	+	–	–	–
337.	*An. schueffneri* Stanton, 1915	–	–	–	–	–	–	–	–	–	+	–	–
338.	*An. schwetzi* Evans, 1934	–	–	–	–	–	–	+	–	–	–	–	–
339.	*An. sergentii* (Theobald), 1907	–	–	–	–	+	+	+	+	–	–	–	–
340.	*An. seydeli* Edwards, 1929	–	–	–	–	–	–	+	–	–	–	–	–
341.	*An. smithii* Theobald, 1905	–	–	–	–	–	–	+	–	–	–	–	–
342.	*An. solomonis* Belkin, Knight and Rozeboom, 1945	–	–	–	–	–	–	–	–	–	–	–	+
343.	*An. somalicus* Rivola and Holstein, 1957	–	–	–	–	–	–	+	–	–	–	–	–
344.	*An. splendidus* Koidzumi, 1920	–	–	–	+	–	–	–	+	+	+	+	–
345.	*An. squamosus* Theobald, 1901	–	–	–	–	–	–	+	–	–	–	–	–
346.	*An. stephensi* Liston, 1901	–	–	–	+	+	+	–	+	+	+	–	–
347.	*An. stookesi* Colless, 1955	–	–	–	–	–	–	–	–	–	+	–	–
348.	*An. subpictus* Grassi, 1899	–	–	–	–	+	–	–	+	+	+	+	+
349.	*An. sulawesi* Koesoemawinangoen, 1954	–	–	–	+	–	–	–	–	–	+	–	+

350.	*An. sundaicus* (Rodenwaldt), 1925	–	–	–	–	–	–	–	+	+	+	+	+
351.	*An. superpictus* Grassi, 1899	–	–	–	+	+	+	–	+	–	–	–	–
352.	*An. swahilicus* Gillies, 1964	–	–	–	–	–	–	+	–	–	–	–	–
353.	*An. takasagoensis* (Morishita), 1946	–	–	–	–	–	–	–	–	–	–	+	–
354.	*An. tchekedii* De Meillon and Leeson, 1940	–	–	–	–	–	–	+	–	–	–	–	–
355.	*An. tessellatus* Theobald, 1901	–	–	–	–	–	–	–	+	+	+	+	+
356.	*An. theileri* Edwards, 1912	–	–	–	–	–	–	+	–	–	–	–	–
357.	*An. theobaldi* Giles, 1901	–	–	–	–	–	–	–	+	+	–	–	–
358.	*An. turkhudi* Liston, 1901	–	–	–	–	+	+	+	+	+	–	–	–
359.	*An. upemba* Lips, 1960	–	–	–	–	–	–	+	–	–	–	–	–
360.	*An. vagus* Doenitz, 1902	–	–	–	–	–	–	–	+	+	+	–	+
361.	*An. vanhoofi* Wanson and Lebied, 1945	–	–	–	–	–	–	+	–	–	–	–	–
362.	*An. vaneedeni* Gillies and Coetzee, 1987	–	–	–	–	–	–	+	–	–	–	–	–
363.	*An. varuna* Iyengar, 1924	–	–	–	–	–	–	–	+	–	–	–	–
364.	*An. vernus* Gillies and De Meillon, 1968	–	–	–	–	–	–	+	–	–	–	–	–
365.	*An. vinckei* De Meillon, 1942	–	–	–	–	–	–	+	–	–	–	–	–
366.	*An. walravensi* Edwards, 1930	–	–	–	–	–	–	+	–	–	–	–	–

(Contd.)

Table 2: Contd.

S.No.	GENUS *ANOPHELES*	North American	Central American	South American	North Eurasian	Mediterranean	Desert	Afrotropical	Indo-Iranian	Indo-Chinese Hills	Malaysian	Chinese	Australasian
367.	*An. watsonii* (Leicester), 1908	–	–	–	–	–	–	–	–	–	+	–	–
368.	*An. wellcomei* Theobald, 1904	–	–	–	–	–	–	+	–	–	–	–	–
369.	*An. willmori* (James), 1903	–	–	–	–	–	–	–	+	+	–	–	–
370.	*An. wilsoni* Evans, 1934	–	–	–	–	–	–	+	–	–	–	–	–
	SUBGENUS *KERTESZIA*												
371.	*An. bambusicolus* Komp, 1937	–	–	+	–	–	–	–	–	–	–	–	–
372.	*An. bellator* Dyar and Knab, 1906	–	–	+	–	–	–	–	–	–	–	–	–
373.	*An. boliviensis* (Theobald), 1905	–	+	+	–	–	–	–	–	–	–	–	–
374.	*An. cruzii* Dyar and Knab, 1908	–	+	+	–	–	–	–	–	–	–	–	–
375.	*An. gonzalezrinconesi* Cova Garcia, Pulido F. and Escalante de Ugueto, 1977	–	–	+	–	–	–	–	–	–	–	–	–
376.	*An. homunculus* Komp, 1937	–	+	+	–	–	–	–	–	–	–	–	–
377.	*An. laneanus* Correa and Cerqueira, 1944	–	–	+	–	–	–	–	–	–	–	–	–
378.	*An. lepidotus* Zavortink, 1973	–	–	+	–	–	–	–	–	–	–	–	–
379.	*An. neivai* Howard, Dyar, and Knab, 1912	+	+	+	–	–	–	–	–	–	–	–	–

380.	*An. pholidotus* Zavortink, 1973	–	+	+	–	–	–	–	–	–	–	–	–
381.	*An. rollai* Cova Garcia, Pulido F. and Escalante de Ugueto, 1977	–	–	+	–	–	–	–	–	–	–	–	–
	SUBGENUS *LOPHOPODOMYIA*												
382.	*An. gilesi* (Peryassu), 1908	–	–	+	–	–	–	–	–	–	–	–	–
383.	*An. gomezdelatorrei* Levi-Castillo, 1955	–	–	+	–	–	–	–	–	–	–	–	–
384.	*An. oiketorakras* Osorno-Mesa, 1947	–	–	+	–	–	–	–	–	–	–	–	–
385.	*An. pseudotibiamaculatus* Galvao and Barretto, 1941	–	–	+	–	–	–	–	–	–	–	–	–
386.	*An. squamifemur* Antunes, 1937	–	+	+	–	–	–	–	–	–	–	–	–
387.	*An. vargasi* Gabaldon, Cova Garcia, and Lopez, 1941	–	–	+	–	–	–	–	–	–	–	–	–
	SUBGENUS *NYSSORHYNCHUS*												
388.	*An. albimanus* Wiedemann, 1820	+	–	+	–	–	–	–	–	–	–	–	–
389.	*An. albitarsis* Lynch Arribalzaga, 1878	–	–	+	–	–	–	–	–	–	–	–	–
390.	*An. allopha* Peryassu, 1921	–	–	+	–	–	–	–	–	–	–	–	–
391.	*An. anomalophyllus* Komp, 1936	–	+	–	–	–	–	–	–	–	–	–	–
392.	*An. antunesi* Galvao and Amaral, 1940	–	–	+	–	–	–	–	–	–	–	–	–
393.	*An. aquasalis* Curry, 1932	–	+	+	–	–	–	–	–	–	–	–	–

(Contd.)

Table 2: Contd.

S.No.	GENUS *ANOPHELES*	North American	Central American	South American	North Eurasian	Mediterranean	Desert	Afrotropical	Indo-Iranian	Indo-Chinese Hills	Malaysian	Chinese	Australasian
394.	*An. argyritarsis* Robineau-Desvoidy, 1827	+	+	+	–	–	–	–	–	–	–	–	–
395.	*An. benarrochi* Gabaldon, Cova Garcia, and Lopez, 1941	–	–	+	–	–	–	–	–	–	–	–	–
396.	*An. braziliensis* (Chagas), 1907	–	+	+	–	–	–	–	–	–	–	–	–
397.	*An. darlingi* Root, 1926	+	+	+	–	–	–	–	–	–	–	–	–
398.	*An. deaneorum* Rosa-Freitas, 1989	–	–	+	–	–	–	–	–	–	–	–	–
399.	*An. evansae* (Brethes), 1926	–	–	+	–	–	–	–	–	–	–	–	–
400.	*An. galvaoi* Causey, Deane, and Deane, 1943	–	–	+	–	–	–	–	–	–	–	–	–
401.	*An. ininii* Senevet and Abonnenc, 1938	–	–	+	–	–	–	–	–	–	–	–	–
402.	*An. lanei* Glavao and Amaral, 1938	–	–	+	–	–	–	–	–	–	–	–	–
403.	*An. lutzii* Cruz, 1901	–	–	+	–	–	–	–	–	–	–	–	–
404.	*An. marajoara* Galvao and, Damasceno, 1942	–	+	+	–	–	–	–	–	–	–	–	–
405.	*An. nigritarsis* (Chagas), 1907	–	–	+	–	–	–	–	–	–	–	–	–
406.	*An. noroestensis* Galvao and Lane, 1937	–	–	+	–	–	–	–	–	–	–	–	–
407.	*An. nuneztovari* Gabaldon, 1940	–	–	+	–	–	–	–	–	–	–	–	–

408. *An. oswaldoi* (Peryassu), 1922	–	+	+	–	–	–	–	–	–	–	–	–
409. *An. parvus* (Chagas), 1907	–	–	+	–	–	–	–	–	–	–	–	–
410. *An. pictipennis* (Philippi), 1865	–	–	+	–	–	–	–	–	–	–	–	–
411. *An. rangeli* Gabaldon, Cova Garcia, and Lopez, 1940	–	–	+	–	–	–	–	–	–	–	–	–
412. *An. rondoni* (Neiva and Pinto), 1922	–	–	+	–	–	–	–	–	–	–	–	–
413. *An. sanctielii* Senevet and Abonnenc, 1938	–	–	+	–	–	–	–	–	–	–	–	–
414. *An. sawyeri* Causey, Denane, Denane and Sampaio, 1943	–	–	+	–	–	–	–	–	–	–	–	–
415. *An. strodei* Root, 1926	+	+	+	–	–	–	–	–	–	–	–	–
416. *An. triannulatus* (Neiva and Pinto), 1922	–	+	+	–	–	–	–	–	–	–	+	–
417. *An. triannulatus davisi* Patterson and Shannon, 1927	–	–	+	–	–	–	–	–	–	–	–	–
418. *An. trinkae* Faran, 1979	–	–	+	–	–	–	–	–	–	–	–	–
SUBGENUS *STETHOMYIA*												
419. *An. acanthotorynus* Komp, 1937	–	–	+	–	–	–	–	–	–	–	–	–
420. *An. canorii* Floch and Abonnenc, 1945	–	–	+	–	–	–	–	–	–	–	–	–
421. *An. kompi* Edwards, 1930	–	+	+	–	–	–	–	–	–	–	–	–
422. *An. nimbus* (Theobald), 1902	–	+	+	–	–	–	–	–	–	–	–	–
423. *An. thomasi* Shannon, 1933	–	–	+	–	–	–	–	–	–	–	–	–

Table 3: COUNTRIES UNDER 12 EPIDEMIOLOGICAL ZONES OF MALARIA

NORTH AMERICAN		CENTRAL AMERICAN		SOUTH AMERICAN	
CODE	COUNTRIES	CODE	COUNTRIES	CODE	COUNTRIES
A2	Alaska	C12	Cayman Islands	A8	Argentina
A5	Amazonia	C15	Costa Rica	B12	Bolivia
A9	Antigua & Barbuda	C17	Cuba	B15	Brazil
B1	Bahamas	D5	Dominican Republic	C9	Chile
B8	Berlin	E3	El Salvador	C12	Colombia
B9	Bermuda	G9	Guatemala	E1	Ecuadior
C3	Canada	H2	Haiti	F5	French Guiana
D4	Dominica	H3	Hondrus	G10	Guina
G7	Grenada	J1	Jamaica	G13	Guyana
J1	Jamaica	N8	Nicaragua	P4	Paraguay
L3	Lesser (Antilles)	P2	Panama	P5	Peru
M11	Martinique	V2	Venezuela	P9	Puerto Rico
M14	Mexico	W1	West Indies	S22	Surinam
S3	Santa Cruz Islands			U3	Uruguay
S5	Sardinia				
S8	Sicily				
S17	St. Kitts-Nivis				
S18	St. Lucia				
S19	St. Vincent				
U4	U.S.A.				
NORTH EURASIAN		**MEDITERRANEAN**		**DESERT**	
CODE	COUNTRIES	CODE	COUNTRIES	CODE	COUNTRIES
A1	Afghanistan	A3	Albania	A4	Algeria
A6	Andorra	A4	Algeria	B2	Bahrain
A11	Austria	B5	Belgium	E2	Egypt
C11	Common Wealth of Independent States	B17	Bulgaria	I4	Iraq
C19	Czechoslovakia	C18	Cyprus	J3	Jordan
D2	Denmark	G5	Gibraltar	L6	Libya
F2	Finland	G6	Greece	M19	Morocco
F4	France	I7	Israel	S1	Sahara
G3	Germany	I8	Italy	S6	Saudi Arabia
H5	Hungary	L2	Lebanon	S26	Syria
I1	Iceland	M9	Malta	T6	Tunisia
I2	India	M16	Monago	W3	West Sahara
I4	Iran	M18	Morocco	Y1	Yemen North
I5	Iraq	P8	Portugal		
I6	Ireland	S2	San Marino		
L7	Liechtenstein	S15	Spain		
L8	Luxembourg	S25	Switzerland		
M17	Mongolia	T7	Turkey		
N4	Netherlands	Y3	Yugoslavia		
N11	Norway				
P7	Poland				
R2	Romania				
S24	Sweden				
U6	U.K.				
AFROTROPICAL		**AFROTROPICAL**		**INDO-IRANIAN**	
CODE	COUNTRIES	CODE	COUNTRIES	CODE	COUNTRIES
A7	Angola	M4	Malawi	C13	Comoros
B6	Belize	M8	Mali	I2	India
B7	Benin			15	Iraq
B14	Botswana				

Contd.

Table 3: Contd.

AFROTROPICAL

CODE	COUNTRIES
B18	Burkina Faso
B19	Burundi
C2	Cameroon
C4	Cape Verde
C5	Cape Verde Islands
C7	Central African Republic
C8	Chad
C14	Congo
D1	Dahomey
D3	Djibouti
E5	Ethiopia
E4	Equatorial Guinea
G1	Gabon
G2	Gambia
G4	Ghana
G11	Guinea
G12	Guinea-Bissak
I9	Ivory Coast
K1	Kenya
L4	Lesotho
L5	Liberia
M2	Madagascar
M3	Malagary Republic

AFROTROPICAL

CODE	COUNTRIES
M12	Mauritania
M16	Monago
M19	Mozambique
N1	Namibia
N9	Niger
N10	Nigeria
R1	Rhodesia
R3	Rwanda
S4	Sao Tome Principal
S7	Senegal
S10	Sierra-Leone
S13	Somalia
S14	South Africa
S20	Sudan
S23	Swazibad
S27	South West African Republic Organization
T2	Tanzania
T4	Togo
U1	Uganda
U2	Upper Volta
Y2	Yemen West
Z1	Zaire
Z2	Zambia
Z3	Zimbabwe

INDO-IRANIAN

CODE	COUNTRIES
K5	Kuwait
M7	Maldives
M21	Muscat
O1	Oman
P1	Pakistan
Q1	Qatar
S6	Saudi Arabia
S9	Seychelles
S16	Sri Lanka
U5	United Arab Emirates

INCO-CHINESE HILLS

CODE	COUNTRIES
B4	Bangladesh
B10	Bhutan
C1	Cambodia
C10	China
H1	Hainan Island
I2	India
L1	Laos
M1	Macau
M20	Myanmar
N3	Nepal
S11	Singapore
S21	Sumatra
T1	Taiwan
T3	Thailand
V3	Vietnam

MALAYSIAN

CODE	COUNTRIES
B3	Bangka Island
B13	Borneo
B16	Brunei
C6	Celebes
F3	Formosa
G8	Guam
H4	Hong Kong
I3	Indonesia
M5	Malaya
M6	Malaysia
M15	Molucca
P6	Philippines

CHINESE

CODE	COUNTRIES
C10	China
C11	C.I.S.
J2	Japan
K3	Korea North
K4	Korea South
R4	Ryokyo Island
T1	Taiwan

AUSTRALASIAN

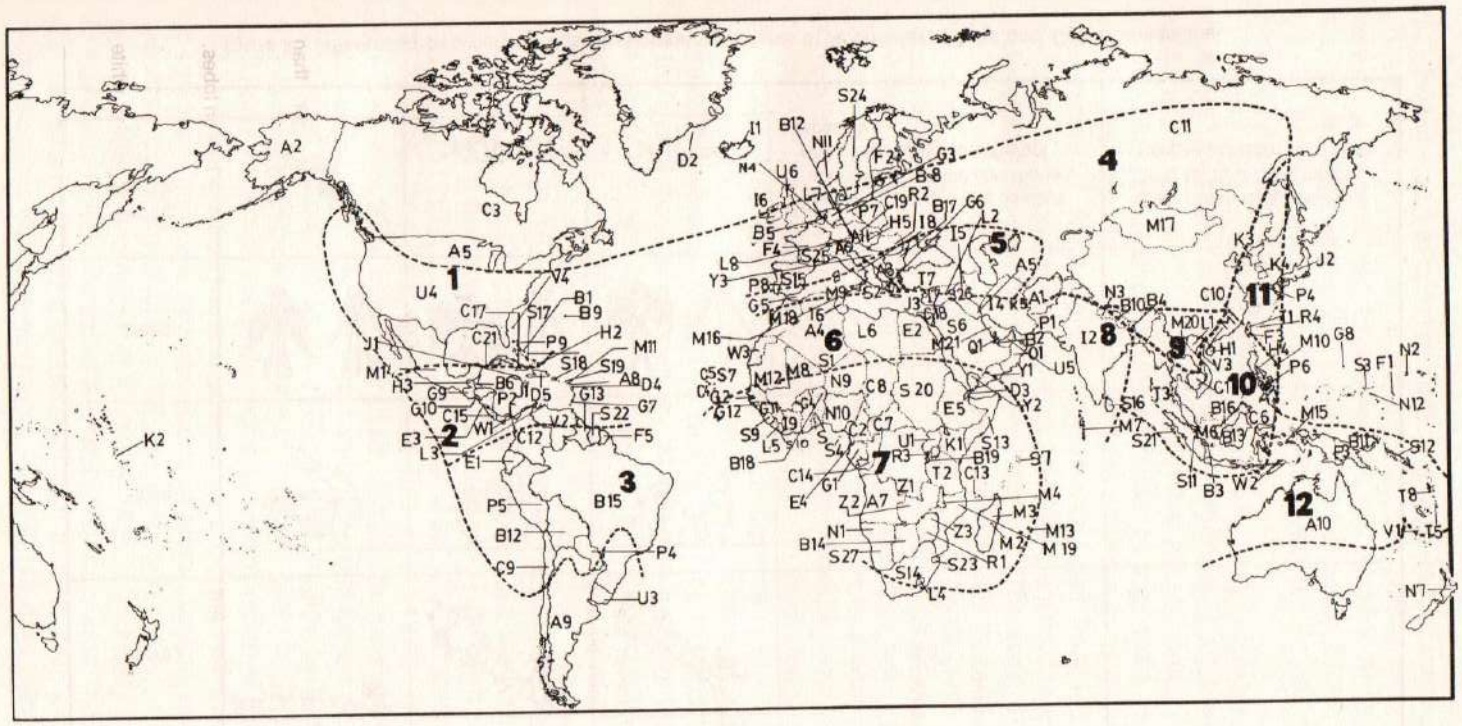
CODE	COUNTRIES
A10	Australia
B11	Bismarck Archipelago
F1	Fiji
K2	Kiribati
M10	Mariana Islands
M13	Mauritius
N2	Nauru
N6	New Guinea

AUSTRALASIAN

CODE	COUNTRIES
N7	New Zealand
P3	Papua New Guinea
S12	Solomon Islands
T5	Tonga
T8	Tuvalu
V1	Vanatua
V4	Virgin Islands
W2	West Irian

Table 4: DIFFERENCES BETWEEN *ANOPHELES* AND *CULEX* MOSQUITOES

Anopheles	*Culex*
EGG	
(1) Shape Boat like, provided with lateral floats.	Elongated, no lateral floats.
(2) Number per Oviposition: 80–140 Laid singly	90–170 Laid singly (*Aedes*) in rafts (*Culex*) or in cluster (Mansoniodes).
LARVA	
(1) Position Float parallel to the surface of water.	Hangs from surface of water.
(2) Siphon tubes	
Absent	Present
(3) Movement Characteristic swift movements.	Much slower and often snake-like movements.
(4) Respiratory opening On 8th abdominal segment.	At the end of siphon tube.
(5) Palmate hairs Present on abdominal segments arranged in pairs (sometimes on metathorax).	Absent
PUPA	
(1) Siphon tubes Funnel shaped, short and broad.	Long and narrow.
ADULT	
(1) Resting posture Proboscis, head and abdomen are in a straight line with abdomen pointing away from resting surface.	Proboscis and body are not in a straight line, the abdomen being inclined towards resting surface.
(2) Wings Generally spotted with white and dark scales.	Generally unspotted with only dark scales.
(3) Palpi	
Female Palpi slender and equal to the proboscis.	Palpi stub-like, reduced.
Male Club-shaped at distal ends and nearly equal to proboscis.	Pointed, bent and usually longer than proboscis.
(4) Scutellum Half-moon-shaped with a uniform row of hairs along the margin.	Trilobed, with three bunches of hair on lobes.
(5) Abdomen Without scales or with a few scattered scales.	With uniform rows of overlapping flat, white and dark scales.



1. North American
2. Central American
3. South American
4. North Eurasian
5. Mediterranean
6. Desert
7. Afrotropical
8. Indo—Iranian
9. Indo—Chinese Hills
10. Malaysian
11. Chinese
12. Australasian

Source: WHO/VBC/89.967

Figure 1: The zones of malaria epidemiology.

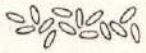
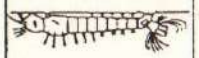
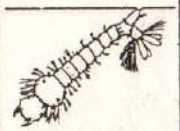
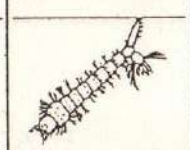
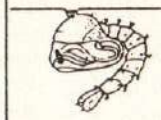
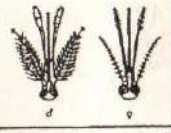
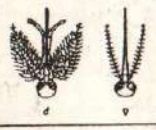
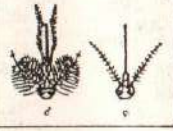
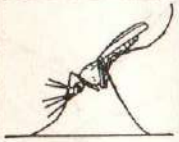
Name	Figure			Development period in days	Optimum temperature
	ANOPHELINES	CULICINES			
	ANOPHELES	AEDES	CULEX		
Eggs				1.5-2	22^0- 28^0C for all stages
Larva				6-8	
Pupa				1.5-2	
Head				Nil	Nil
Resting Position				Female approximately 30 days under ideal natural conditions; male 2 to 6 days for different species	Daily mean temperature 28°C to 30°C Daily mean relative humidity 60 to 80%

Figure 2: Differences between various developmental stages of *Anopheles*, *Aedes* and *Culex* mosquitoes.

James and Liston (1904), in a monograph on the anopheline mosquitoes of India, divided Indian anophelines into 10 groups: (1) *An. barbirostris*, *An. nigerrimus*; (2) *An. leucosphyrus*, *An. punctulatus*; (3) *An. pulcherrimus*, *An. willmori*; (4) *An. karwari*, *An. fuliginosus*, *An. jamesii*, *An. maculipalpis*, *An. theobaldi*, *An. maculatus*; (5) *An. jeyporiensis*, *An. listoni*, *An. culicifacies*; (6) *An. rossi*, *An. stephensi*; (7) *An. turkhudi*; (8) *An. lindesayi*, *An. gigas*; (9) *An. aitkeni*, *An. immaculatus* and (10) *An. culiciformis*.

In the revised edition published in 1911, they re-grouped the Indian anophelines into 13 genera: *Neostethopheles, Patagiamyia, Myzomyia, Anopheles, Pyretophorus, Nyssorhynchus, Nyssomyzomia, Neomyzomia, Neocellia, Cellia, Myzorhynchus, Christophersia*, and *Aldrichia* (40 spp. and 5 varieties). Christophers (1916) dealt with the synonyms and the correct names of the species of anophelines recorded. A total of 38 species was listed from India. Edwards in 1932 prepared a comprehensive catalogue for the identification of the family Culiciade and reduced the number of genera from 149 (Theobald, 1910) to 30. However, the number of species was increased from 1050 to 1400. Christophers (1933) published a monograph on the identification of anophelines of India, Ceylon (Sri Lanka) and Burma under the title *The Fauna of British India*. In a series of articles published in the *Indian Journal of Medical Research*, from 1923 to 1929, Barraud provided a revision of the culicine and toxorhynchine which eventually led to the publication of his monograph *The Fauna of British India* in 1934. Both Christophers (1933) and Barraud (1934) adopted the classification of Edwards (1932) in the arrangement of tribes, genera and subgenera.

Subsequently, Stone, Knight, and Starcke published a catalogue on the Culicidae of the world in 1959. This was followed by the publication of a catalogue on the systematics of mosquitoes of the world by Knight and Stone in 1977. A first supplement was written by Knight in 1978 and two additional supplements by Ward in 1984 and 1992. The authors raised the number of genera, and species from 31 to 37, and from 2,401 to 3,209 respectively.

The first key in the form of a wall chart to identify the Indian anophelines was published by the Central Malaria Bureau, Kasauli, in 1912. Subsequently several keys were published by Sinton and Covell (wall chart, 1916), Strickland and Choudhury (1927a), Christophers *et al.* (1927), Christophers (1933), Puri (1954, 1960), Wattal and Kalra (1961), and Das *et al.* (1990). Of the above identification keys, only 2 are commonly used, namely the keys of Puri (1960) and Wattal and Kalra (1961). The keys deal with the identification of 40 mosquito species as against the present fauna of 58, except the key by Das *et al.* (1990), which describes 54 species. Also, none of the keys gives a complete account of morphological variations except for some variations reported by Christophers (1933). These morphological variations are very important for the correct identification of species. There are several reports of morphological variations in 24 species recorded by Christophers (1933), Ramakrishna (1954), Subramanian and Nagendra (1955), Bhatnagar *et al.* (1958), Azeez and Beig (1959), Rajagopal and Chakraborty (1960), Wattal *et al.* (1960), Rahman *et al.* (1960), Sen (1962), Nagpal and Sharma (1983 a,b), Gunasekaran *et al.* (1990), and Nagpal (1990). The morphological variations are mostly found in the palpi, wings, and legs.

In 1930, Covell compiled the information available on the distribution of 35 species of Indian anophelines, which was later modified to include 40 species by Puri (1955). On the basis of physiography, climate, and hydrological zones, Rao (1984) compiled information on 51 species, which was updated by Nagpal (1986) to include survey information from 1900 to 1984. The records of gut and gland infections of these anophelines were first tabulated in *Vectors of Malaria in India*, published by the National Malaria Society in 1957. Horsfall (1955), updated in 1972, gives the gut and gland infection in regard to the anophelines of the world in his book *Mosquitoes— Their Bionomics and Relation to Diseases*. Later, Rao (1984) gives an exhaustive account of the biology of the Indian anophelines. In the present monograph an attempt is made to update the information available on adult anophelines, their differences from other genera at every stage, brief distinguishing features of identification of 58 anopheline species, their biology (typeform available, species complex if any, sitting posture, resting habits, breeding habits, biting time, feeding habits, flight range), susceptibility to insecticides, relation to disease, records of vector incriminations for human plasmodia, distribution in India and the world, and morphological variations reported. Also included are a bibliography and a glossary.

MORPHOLOGICAL DESCRIPTION

The life cycle of an anopheline mosquito has four distinct stages: adult, egg, larva and pupa. The adult stage is aerial and the other three stages are aquatic. The terminology used here is taken from Harbach and Knight (1980).

ADULT

The body of an anopheline mosquito comprises the head, the thorax, and the abdomen (Fig. 3). The main parts of the body and their appendages are briefly described here.

Head

The head is the smallest part of the mosquito body, is almost spherical, and is connected to the thorax through a narrow, membranous neck. The head consists of a pair of antennae, a proboscis, a pair of maxillary palpi and a pair of compound eyes (Fig. 4). The eyes occupy the bulk of the surface area of the head. The head is characterized by the presence of white and black scales: the back (occiput) and side portions of the head are covered with black scales while the vertex is covered with white or pale and black scales which are truncated and notched apically, giving a forked appearance. Between the two eyes on the narrow anterior part of the vertex a group of pale or white scales and setae arise which form a tuft, known as frontal or vertical tuft a characteristic of most anophelines.

Maxillary palpi (palpi): A pair of palpi arises from the lower front margin of the head near the proboscis. The palpus has five palpomeres. The small basal segment is designated as the first palpomere, which is fused with the second and is vestigial. The distal segment, which is away from the head, is known as the fifth palpomere (see Fig. 4). The palpi in the female are slender while they are club shaped towards the apical end in males. The palpi are also covered with scales except along their inner surface. The thickness of palpi depends on the type of scales, i.e., whether they are erect or flat. Erect scales give thickness to the palpi (e.g. *An. barbirostris* complex and *An. hyrcanus* complex), while flat scales make them thin (e.g., *An. aitkenii* complex). The pale scales on the palpi form the bands at the joints 2–3 and 3–4, and at the apex. The absence or presence of the pale bands, their number, their width, and the distance between the two bands are important characters for species identification.

The terminology used for the bands present on the palpi is the same as used by Christophers (1933). The pale or the white band which is away from the head, i.e., towards the distal end, is called the apical pale band; the second pale band is known as the subapical pale band; and the third band, which is towards the

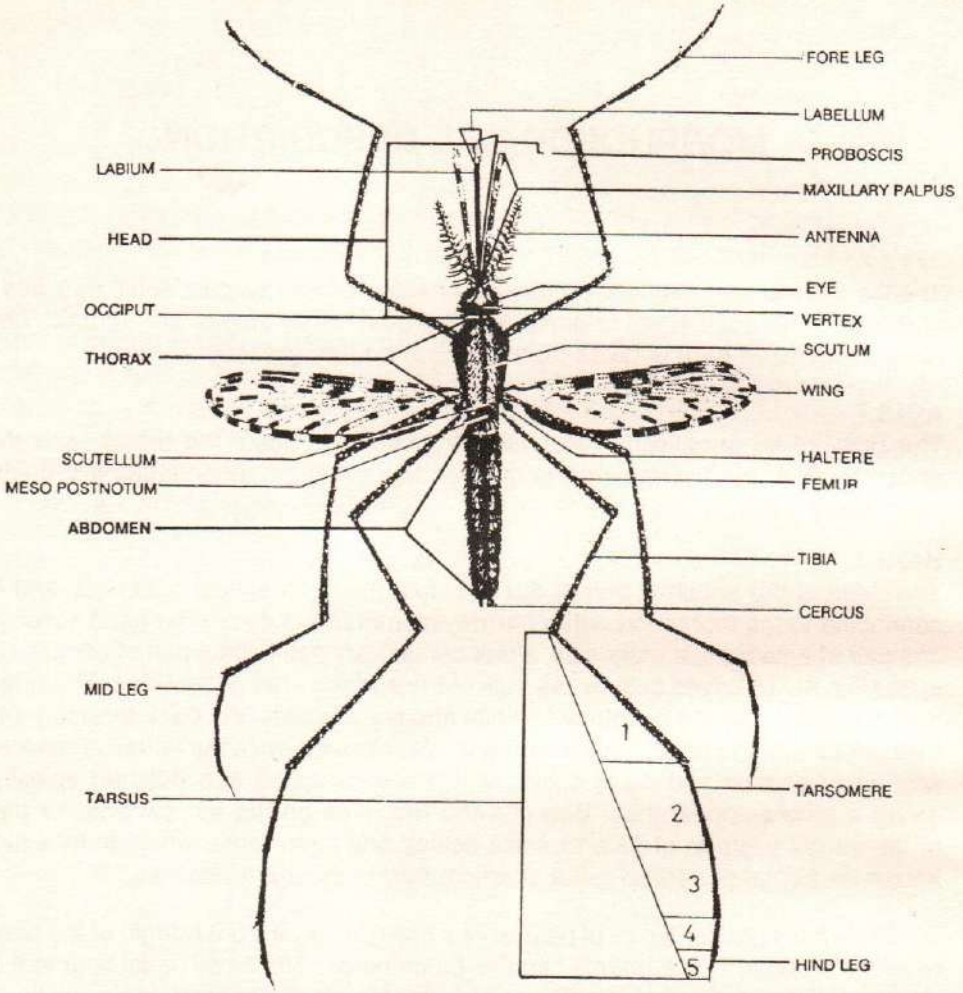


Figure 3: Generalized diagram of a female adult anopheline.

basal side, is known as the basal or proximal pale band. The dark band between the apical and subapical pale bands is known as the pre-apical dark band or intervening dark band. Palpi generally contain three pale bands because of the shorter apical segment. When the apical segment increases in size it frequently contains one more pale band and the palpi become four-banded.

In Indian anophelines the presence of pale bands is more dominant in subgenus *Cellia* but in subgenus *Anopheles* most of the species contain completely dark palpi except for *An. hyrcanus* group species, *An. lindesayi*, *An. nilgirius*, *An. baileyi*, and *An. gigas*. In subgenus *Cellia*, out of the 34 species recorded from India only six contain four-banded palpi: *An. balabacensis*, *An. dirus*, *An. elegans*, *An. pulcherrimus*, *An. karwari*, and *An. tessellatus*. In a few three-banded species, viz., *An. annularis*, *An. pallidus*, *An. subpictus*, *An. vagus*, *An. sundaicus*,

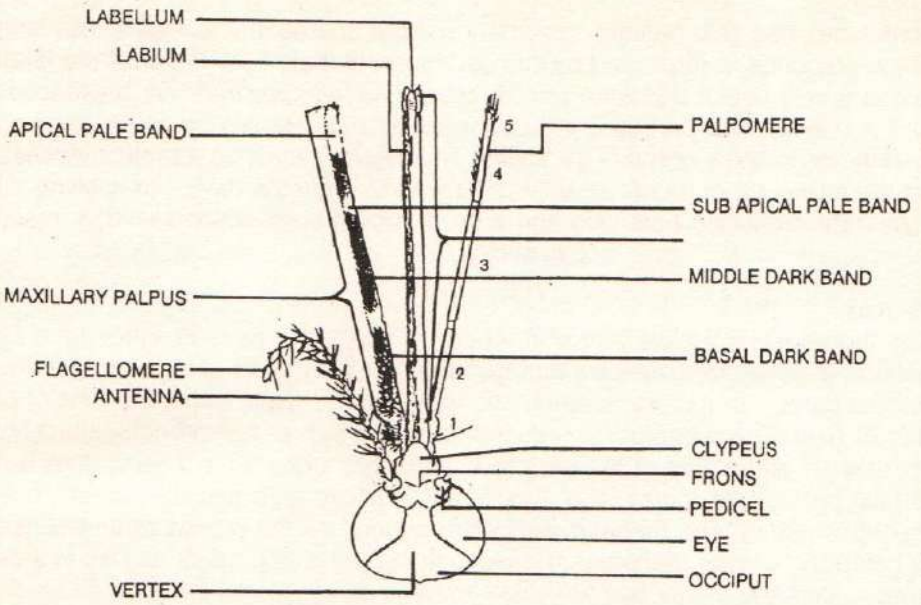


Figure 4: Parts of the head of a female anopheline mosquito.

and *An. fluviatilis*, an extra dark band appears on the apical pale band and gives the appearance of four-banded palpi. This variation creates a problem in the identification, but it is found mostly in winter collections. Another variation which gives the appearance of four-banded palpi and may mislead in the identification is the presence of speckling between the basal and subapical pale bands (middle dark band) of the palpi. Although there are only two species—*An. stephensi* and *An. splendidus*—in India in which speckling is present on the palpi, sometimes speckling is also recorded in *An. maculatus*. The other variation which is common in *An. aconitus* is the absence of the pre- apical dark band which increases the length of the apical pale band and creates confusion in the identification of the species.

Antennae: Antennae are sense organs which arise on the front of the head between the eyes and consist of a flagellum of 13 flagellomeres in females and 14 flagellomeres in males (see Fig. 4). The basal flagellomeres is an inconspicuous ring and is known as torus or pedicel. In the male mosquito the antennae are plumose owing to the presence of whorls of long hairs, and the size of the pedicel is comparatively large. In females the hairs are smaller, fewer, and less conspicuous, and the pedicel and the first few flagellar segments often bear a few scales.

Proboscis: The proboscis projects downwards and forwards from the lower front margin of the head and generally is continuously dark in colour, except the labellum, which is light yellow (Fig. 4). In *An. aconitus, An. kochi,* and *An. tessellatus*, the apical half of the proboscis is flavescent, i.e., turns yellow in colour, and

sometimes has pale patches towards the distal end as in *An. vagus*. The length of the proboscis is measured by comparing it with that of the femur of the foreleg and is a very useful character to differentiate *An. elegans* from *An. balabacensis* and *An. dirus*. The proboscis also consists of a sheath-like structure, known as labium, enclosing a group of six styles. The labium serves as a protective sheath for the styles but does not enter into the wound when the mosquito is biting. The styles enter into the host skin and form a duct through which saliva is injected into the wound and liquid food is sucked in.

Thorax

The thorax is the middle part of the body. It bears two pairs of wings (one pair, haltere, modified for balancing during flight) and three pairs of legs and has three distinct parts—pronotum, scutum, and metanotum—each part consisting of one pair of legs. The pronotum is reduced to form a pair of antepronotal lobes lying dorsally on either side of the neck with a postpronotary area. The scutum is the largest part of the thorax. It is posteriorly attached with a small scutellum and mesopostnotum. The metanotum is also reduced as the pronotum and consists of balancing organs (halteres) and one pair of hind legs (Figs. 5 and 6). In Indian anophelines the thorax has very little importance in the identification of species. The colour of scutum helps in the identification of *An. aitkenii* group, *An. lindesayi*, *An. kochi*, and *An. maculatus*. The presence or absence of hair and setae is useful in the identification of *An. stephensi*, *An. umbrosus* group, *An. turkhudi* and *An. multicolor*.

Wings: A pair of wings arises from the scutum and bears a number of important characters which help to identify the Indian subgenus and species. The wing membrane consists of a number of longitudinal veins, which are connected with each other through small cross veins. The thickened anterior border of the wing is known as costa and parallel to it is the subcosta, which fuses with the costa in the

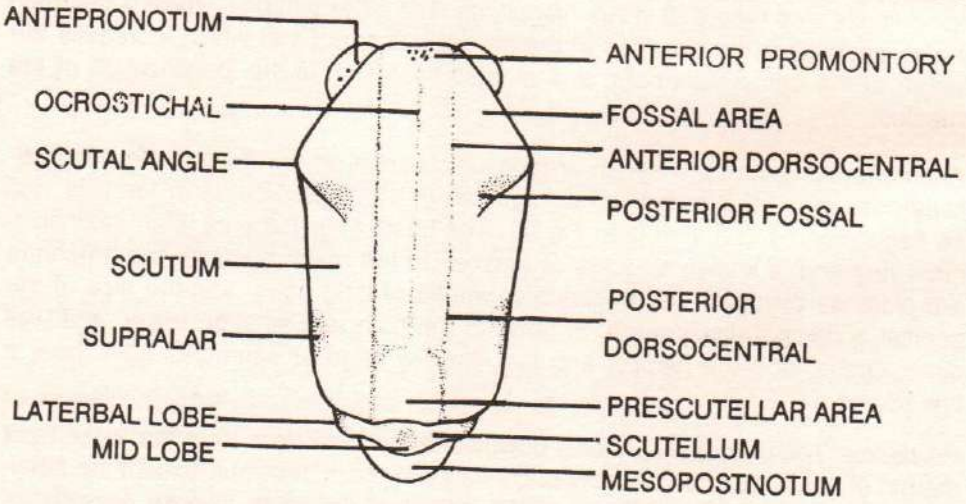


Figure 5: Parts of the thorax of an anopheline mosquito (dorsal view).

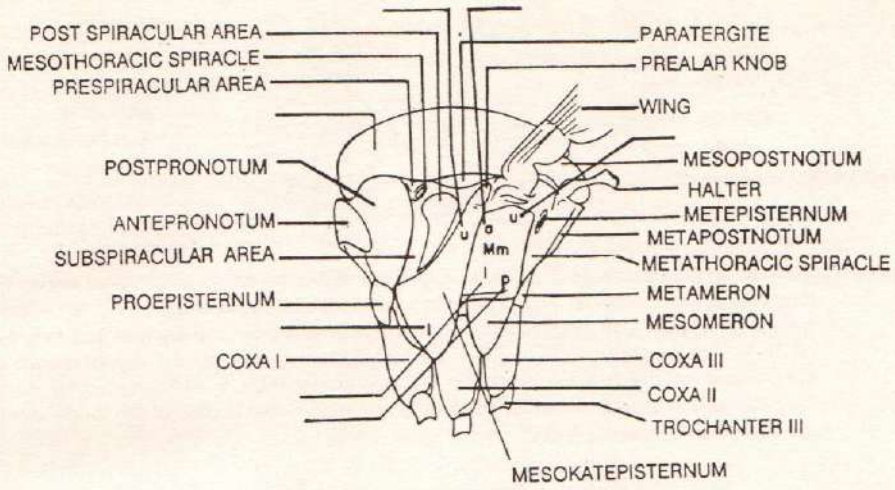


Figure 6: Lateral view of an anopheline thorax.

middle of the anterior border of the wing. Besides these two important veins, there are six longitudinal veins known as veins 1(R1), 2(RS), 3(R4 + 5), 4(M), 5(Cu), and 6(Anal); as given in Fig. 7. Veins 1(R1), 3(R4 + 5), and 6(Anal) are undivided and veins 2(RS), 4(M), and 5(Cu) are bifurcated and their numbers designated 2(RS), 2.1(R2), 2.2(R3), 4(M), 4.1(M1), 4.2(M2), 5(Cu), 5.1(Cu1), 5.2(Cu2). Veins 2(RS) and 4(M) and subcosta are concave and prominent on the under surface of the wing and veins 1(R1), 3(R4 + 5), 5(Cu), and 6(Anal) are convex and prominent on the upper surface of the wing. The cross veins are known as veins 2–3 (RS)–(R4 + 5), 3–4, (R4 + 5)–(M) and 4–5 (M)–(Cu) as they connect the stems of veins 2(RS) and 3(R4 + 5), 3(R4 + 5) and 4(M) and 4(M) and 5(Cu) respectively (Fig. 7). The part of vein 2(RS) between its bifurcation and the origin of the 2–3 cross vein is known as petiole, an important character in the identification. The areas of the wing enclosed by the branches of veins 2(RS) and 4(M) are known as anterior and posterior forked cells respectively, these being the most important characters to ident'.y the species *An. moghulensis*. This species resembles *An. jeyporiensis* but can be easily identified by measuring the distance of the anterior forked cell from the base of the wing, which is more in this species than in *An. jeyporiensis*. The costa, subcosta, and veins 1(R1) to 6(Anal) are covered with scales on both the upper and under surfaces. Both the type of scales and their size vary from place to place on different veins. The scales are known as squame, plume, fringe, and border scales (Christophers 1933).

The ornamentation of the wing or scaling on the wing is of great importance in identification. Generally in all Indian anophelines, dark and white areas alternate with each other, but in *An. barbirostris* and *An. nigerrimus* white and black scales on some veins are mixed together and give a speckled appearance. There are seven species in Indian fauna in which the wing is completely dark, giving a *Culex* like appearance. These species are *An. aitkenii, An. culiciformis, An. bengalensis, An. pinjaurensis, An. insulaeflorum, An. sintoni*, and *An. barianensis* of the subgenus *Anopheles*. In India only two subgenera are recorded, viz. *Cellia*

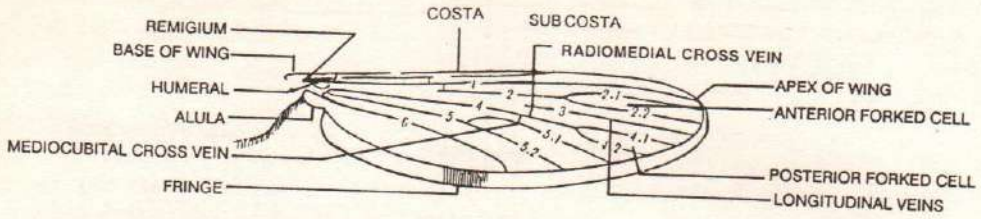


Figure 7: Wing of an anopheline mosquito showing costa, subcosta and 6 longitudinal veins; 1–first longitudinal vein (Radius, R1); 2–second longitudinal (Radial sector, Rs); 2.1–upper or anterior branch of 2nd longitudinal (R2); 2.2–lower or posterior branch of 2nd longitudinal (R 3); 3–third longitudinal (R4+5); 4–fourth longitudinal (Media, M); 4.1–upper branch of 4th longitudinal (M1); 4.2–lower branch of 4th longitudinal (M2); 5–fifth longitudinal (Cubitus, Cu); 5.1–upper branch of 5th longitudinal (Cu1); 5.2–lower branch of 5th longitudinal (Cu 2); 6–sixth longitudinal (Anal).

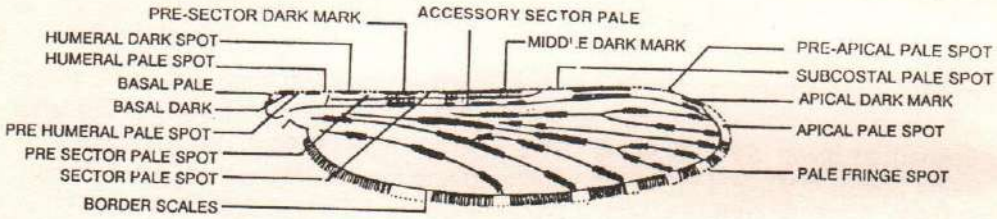


Figure 8: Wing showing position of pale and dark spots and their nomenclature.

and *Anopheles*. In subgenus *Cellia* the dark and pale areas are very clear on the wings, especially on costa, subcosta and vein 1(R1). These pale and dark areas, also known as spots, have a characteristic position and are of great importance in the identification of subgenus and species. The subgenus *Cellia* has four or more pale areas while the subgenus *Anopheles* has three or fewer pale areas (also, the wing is completely dark) on costa and subcosta, including vein 1(R1). These pale and dark areas are recognized by their names (Fig. 8). The medium pale area, i.e. subcostal pale spot, is present a little beyond the middle of the costa where the subcosta join the costa. The dark area which starts after the subcostal pale spot towards the distal side (i.e. nearer the apex of the wing) is known as the pre-apical dark mark followed by the pre-apical pale spot, apical dark mark, and apical pale spot. The pale spot, which is present just before the subcostal dark spot (i.e. towards the base of the wing), is known as the middle dark spot followed by the accessory sector pale spot (present mostly on vein 1(R1)), sector pale spot, pre-sector dark spot, pre sector pale spot, and a few other pale and dark spots, which vary in number and position and are important in the identification of the species. The terminology given above for the dark and pale areas is taken from Harbach and Knight 1980; but different authors have used different terminologies for the dark and pale areas. The names used by different authors are given in Table 5 (taken from Wilkerson and Peyton, 1990).

Towards the apex and hind margin of the wing, fringe scales or spots are present; usually the fringe scales are pale in colour and are present opposite to the end of the veins. Their number and presence or absence is very useful in the identification of some Indian anophelines.

Legs: There are three pairs of legs originating from the lower side of the thorax: the forelegs, midlegs and hindlegs. Each leg consists of conical coxa, a small hinge-like trochanter, a long femur, a slender tibia, and a five-segmented tarsus (Fig. 9). The fifth tarsomere, which is towards the end of the leg, is smallest in size while the first tarsomere, which is attached with the tibia, is longest in size (nearly equal to the tibia) in female mosquitoes. But in male mosquitoes the fifth tarsomere is often longer than the fourth tarsomere of the foreleg. The fifth tarsomere of each leg consists of claws in females but the foreleg of the male consists of very few spurred claws with some stout hairs.

Ornamentation of the leg is of great importance in identification. The ornamentation is dependent on the presence or absence of the pale and dark bands on the different parts of the leg. The legs are covered with small oppressed scales except the coxae and sometimes the trochanter. Both the femur and tibia are sometimes pale towards their tips, and this condition is referred to as tibia or femur with knee spots. The presence of a broad pale area at the junction of tibia and tarsal of the hind leg is of great importance in the identification of *An. balabacensis, An. elegans* and *An. dirus* complex. In some species the femur of forelegs is swollen in their basal half and sometimes the femur and tibia both pale towards the posterior side.

In the case of *An. lindesayi* the hind femur has basal and subapical pale bands or sometimes the femur has a tuft of pale scales in place of subapical pale band which can be seen through the naked eye as in the case of *An. annandalei* and *An. interruptus* (*An. asiaticus* group). Out of 34 Indian species under the subgenus *Cellia* the legs of 20 species are referred to as speckled legs, due to the presence of scattered and irregular patches of pale spot on the femur, tibia and some tarsal segments. There is no speckled leg in the Indian mosquito under the subgenus *Anopheles*. The most important features of the leg are the tarsal segments. These segments may be completely dark (*An. culicifacies, An. fluviatilis, An. minimus, An. varuna* in subgenus *Cellia* and *An. culiciformis, An. aitkenii* complex in subgenus *Anopheles*) or have pale bands at the joints. There are two types of bands: (1) very narrow bands confined to the apices, i.e., towards the tips only and leaving the bases dark (e.g., *An. jeyporiensis, An. stephensi*), and (2) broad bands spreading across the joints on the bases of the next segment (e.g., *An. subpictus, An. vagus*). These type of bands are more prominent on the foreleg than on the mid- and hind-leg.

In eight Indian species of subgenus *Cellia*—*An. annularis, An. pallidus, An. philippinensis, An. nivipes, An. pseudojamesi, An. jamesii, An. splendidus*, and *An. pulcherrimus*, the pale band is very broad on hind-leg tarsomeres because of the fusion of distal tarsomeres 5,4,3, and apex of 2, which are completely white. It is important that the segments be counted from the tip (segment 5) of the leg to the first dark band.

Table 5: COMPARISON OF SELECTED SYSTEMS FOR NAMING PALE

Proposed nomenclature	Christophers 1913	Root 1926	King 1932	Christophers 1933
Basal pale	Not shown	B1	Not shown	Not shown
Basal dark	Basal accessory spot (in part)	Not named	Inner accessory dark spot (in part)	Inner prehumeral dark accessory spot
Prehumeral pale	Not shown	Not shown	Not shown	Prehumeral pale interr.
Prehumeral dark	Basal accessory spot (in part)	Not named	Inner accessory dark spot (in part)	Outer prehumeral dark accessory spot
Humeral pale	Humeral nodal point	B2	White interr. basal 1/3 of costa	Humeral pale interr.
Humeral dark	Basal accessory pigment area	Not named	Outer accessory dark spot	Humeral dark accessory spot
Presector pale	Inner pale spot	B3	Presector white spot	Presector pale area
Presector dark	Inner main costal spot center	Not named	Presector dark spot	Presector dark spot
Sector pale	Sector nodal point	M1	Sector spot	Sector pale area
Sector dark	Middle main costal spot center	Not named	Midcostal spot	Middle dark spot
Accessory sector pale	Accessory sector nodal point	M2 and M3	Accessory sector spot	Accessory sector pale area
Subcostal pale	Subcostal nodal point	Sc	Subcostal white spot	Subcostal pale area
Preapical dark	Subapical main costal spot center	Not named	Subapical dark spot	Pre-apical dark spot
Preapical pale	C.1	Apical pale (in part)	Subapical white spot	Pre-apical pale area
Apical dark	Apical main costal spot center	Not named	Apical dark spot	Apical dark spot
Apical pale	Apical nodal point	Apical pale (in part)	Apical white spot	Apical pale area

[a]Undivided, prehumeral dark accessory spot.
[b]"C" is pale interruption of third dark area of first vein.
[c]Also contains accessory R1 pale on R1.
[d]When absent, forms the subbasal dark.

AND DARK COSTAL WING SPOTS IN GENUS *ANOPHELES*

Gater 1935	Russell *et al.* 1943	Reid 1968	Gillies & de Meillon 1968	Zavortink 1973
Not named	Not named	Not named	Not shown	Basal pale
Inner prehumeral dark accessory spot[a]	Not shown	Prehumeral dark mark (in part)	Not named	Basal dark (in part)
Prehumeral pale interr.	H1	Prehumeral pale spot	Not shown	Not shown
Outer prehumeral dark accessory spot[a]	Not named	Prehumeral dark mark (in part)	Not named	Basal dark (in part)
Humeral pale	H2	Humeral pale spot	"a," humeral pale marking	Humeral pale
Humeral dark accessory spot	Not named	Humeral dark mark	Not named	Humeral dark (in part)
Presector pale area	H3	Presector pale spot	"a," presector pale	Not shown
Presector dark spot	Basal dark spot	Presector dark mark	"A"	Humeral dark (in part)
Sector pale area	Sectoral spot	Sector pale spot	"b," sector spot	Presectoral pale
Middle dark spot	Median dark spot	Middle dark mark	"B"	Presect. dark (in part) sectoral dark (in part)
Accessory sector pale area	Accessory sector spot	Accessory sector pale spot	"b," accessory sector pale spot	Sectoral pale
Subcostal pale area	Subcostal spot	Subcostal pale spot	"c," subcostal spot	Subcostal pale
Pre-apical dark spot	Pre-apical dark spot	Pre-apical dark mark	"C"[b]	Pre-apical dark
Pre-apical pale area	Pre-apical spot	Pre-apical pale spot	"d," subapical spot	Pre-apical pale
Apical dark spot	Apical dark spot	Apical dark mark	"D"	Not named
Apical pale area	Apical spot	Apical pale spot	"e," apical spot	Not shown

(Contd.)

Table 5: Contd.

Proposed nomenclature	Harrison & Scanlon 1975	Faran 1980	Harrison 1980	Harbach & Knight 1980
Basal pale	Not shown	Basal pale	Basal pale	Basal pale
Basal dark	Inner prehumeral accessory dark	Not shown	Basal dark	Basal dark
Prehumeral pale	Prehumeral pale	Basal pale	Prehumeral pale	Prehumeral pale
Prehumeral dark	Not named	Basal dark	Prehumeral dark	Prehumeral dark
Humeral pale	Humeral pale	Humeral pale	Humeral pale	Humeral pale
Humeral dark	Humeral dark	Subbasal dark	Humeral dark	Humeral dark
Presector pale	Presector pale	Subbasal pale	Presector pale	Presector pale[d]
Presector dark	Presector dark	Presectoral dark	Presector dark	Presector dark
Sector pale	Sector pale	Presectoral pale	Sector pale	Sector pale
Sector dark	Middle dark	Sectoral dark (in part) subcostal dark (in part)	Sector dark	Median dark
Accessory sector pale	Accessory sector pale	Sectoral pale	Accessory sector pale	Accessory sector pale
Subcostal pale	Subcostal pale	Subcostal pale	Subcostal pale	Subcostal pale
Pre-apical dark	Pre-apical dark	Pre-apical dark	Pre-apical dark[c]	Pre-apical dark
Pre-apical pale	Pre-apical pale	Pre-apical pale	Pre-apical pale	Pre-apical pale
Apical dark	Apical dark	Apical dark	Apical dark	Apical dark
Apical pale	Not named	Not shown	Apical pale	Apical pale

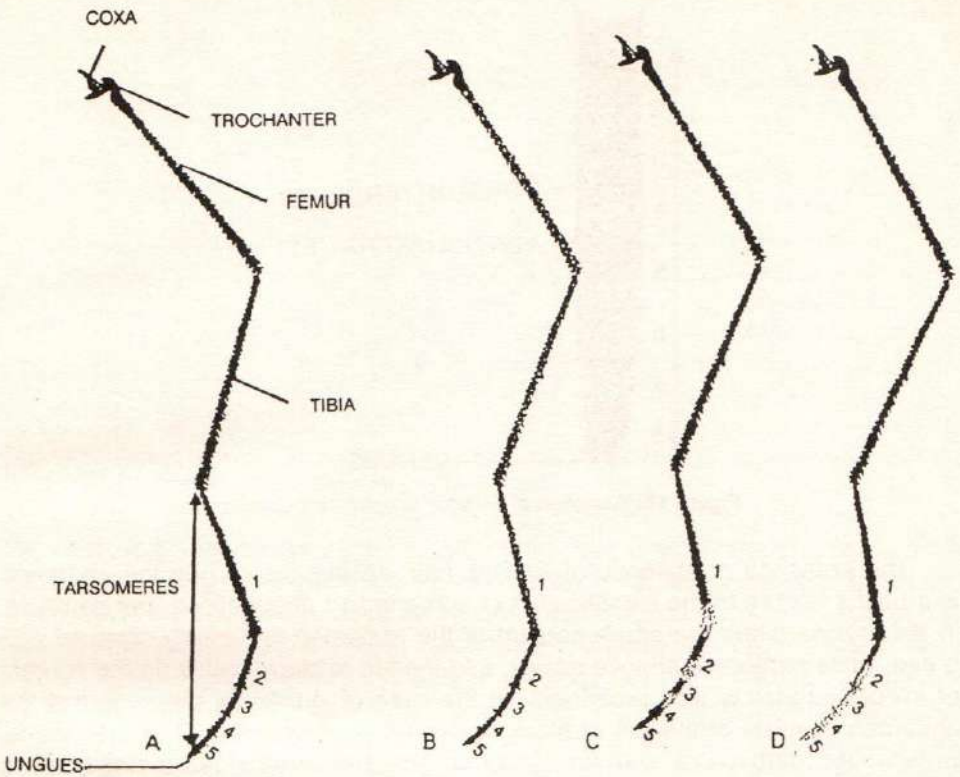


Figure 9: Leg of an anopheline mosquito showing different parts (A); speckling on femur, tibia and tarsomeres (B); foreleg tarsomeres with broad pale bands (C); hind tarsomeres 5, 4 and 3 portion of 2nd completely white (D).

In the case of *An. maculatus, An. theobaldi, An. willmori, An. pseudowillmori* only the tarsomeres 5 and 4 of the hind leg are completely white. Sometimes in a few cases the tarsomere 5 of *An. kochi, An. balabacensis, An. elegans, An. dirus* complex and *An. tessellatus* is not completely white and therefore old keys refer to their identification at two places; but because of the presence of four-banded palpi, however, the identification of these species in this book is given at only one place.

Abdomen

The abdomen of anophelines is composed of 10 segments but externally only eight segments can be seen, the last two being modified into genital organs (Fig. 10). The dorsal part of the abdomen is called dorsum and the segments are known as tergites; the ventral side is known as venter and segments are called sternites. The tergites and sternites join laterally through a membrane known as pleural membrane anteriorly and as intersegmental membranes posteriorly. In the case of male anophelines the dorsal surface of the eighth segment is made up of sternite instead of tergite as after emergence this segment rotates with genitalia at an angle of 180°.

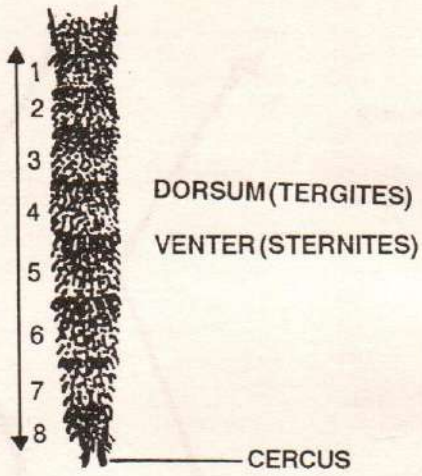


Figure 10: Abdomen of an adult anopheline mosquito.

The presence or absence of scaling, hair, coxites, or ceri on the abdomen is a useful feature in the identification of some Indian anophelines. For example, in *An. pulcherrimus* the entire dorsum of the abdomen is densely covered with broad, white battledore-shaped scales, and the tuft of black scales on the corners of middle tergites is also prominent. In the case of *An. kochi* the venter of the abdomen consists of the tuft of black scales on segments 2 to 7 at their joints, while in *An. barbirostris* and *An. hyrcanus* group of mosquitoes a single tuft is present on segment 7 only.

Male genitalia: The male genitalia is also known as external genitalia, terminalia, or hypopygium—a copulatory apparatus. The detailed structure of the genitalia is given in Fig. 11. The most important parts of the genitalia on which the identification of species is based are parabasal and other setae on the inner sides of the ganolorites, the claspette lobes with their-setae or clubs, and the single median aedeagus with its paired terminal leaflets. In Indian anophelines, however, genitalia are used in the identification of only *An. pinjaurensis* (*aitkenii* complex), in which the aedeagus is very long and large, expanded at opening with a thickened rim and entirely devoid of leaflets or processes.

Female genitalia: Female genitalia have no special characters which can help in the species identification, but they may be of use in the separation of species belonging to subgenus *Anopheles* from subgenus *Cellia*. In subgenus *Anopheles* transparent dots are present all over the spermatheca and a horseshoe-shaped structure is present near the spermatheca, while in subgenus *Cellia* the dots are restricted to certain areas on spermatheca and the horseshoe-shaped structure is absent (Hara, 1959).

EGGS

There are three types of mosquito eggs: (1) those laid singly on the surface of

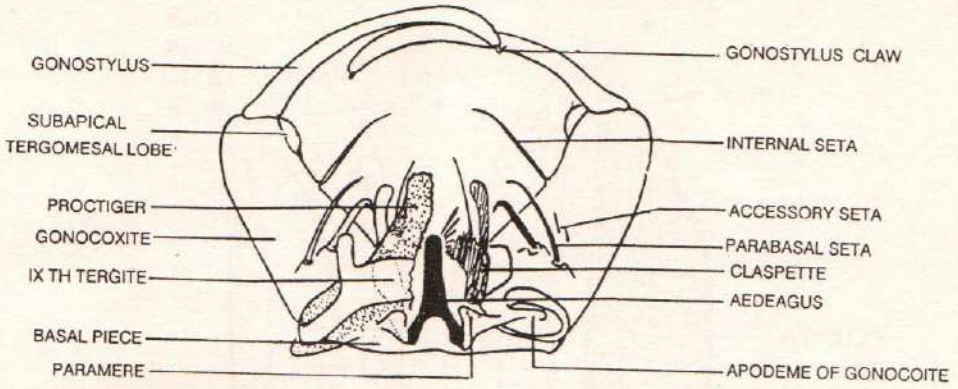


Figure 11: Male genitalia of an anopheline mosquito, true dorsal view (actual ventral after rotation), right half of proctiger and 9th tergite removed.

the water, e.g. *Anopheles*; (2) those glued together to form rafts that float on the water surface, e.g. *Culex, Culiseta, Mansonia*, and *Uranotaenia*; and (3) those laid singly out of water on wet surface, e.g. *Orthopodomyia* and some species of genus *Aedes*. Generally, eggs which are laid on water surface hatch within two to three days. Eggs of some species belonging to genera *Aedes* and *Psorophora* survive up to three to four years on wet grounds till the surface becomes flooded. Eggs of anophelines are white in colour when first deposited on the surface of water but darken after a few hours. The eggs are laid singly on the water surface and lie lengthwise on the water. These eggs are elongated, oval and pointed at one end (boat-shaped), and provided with a pair of lateral floats. The average length of an egg is about 1 mm. The number of eggs laid by a single female anopheline mosquito varies from 80 to 150 depending on the species. The inner and outer walls of the egg are known as endochorion and the exochorion respectively. The general appearance of an anopheline egg is shown in Fig. 12.

The shape, size, inside view of upper surface (concave, convex, or flat), number of floats or ribs, and the shape and width of the deck of the eggs vary from species to species. For example, the width of the deck is very useful to differentiate *An. hyrcanus* complex from *An. barbirostris*. The number of the floats on the egg surface also differentiates *An. stephensi* type form from *An. stephensi* var. *mysorensis* and *An. stephensi* intermediate.

LARVAE

Larvae hatch from the eggs and live in water. Mosquitoes have a strong preference for particular breeding sites. Some larvae develop in permanent waters like canals, ponds, wells, and riverbed pools, and some in temporary waters like pools, rainwater collections, tree holes, or leaf axils. For example, *An. sundaicus* larvae always develop in brackish waters, and *An. minimus* larvae in streams. The larvae get their food from the water and breathe by coming to the surface of water, except *Mansonia* larvae which attach themselves to aquatic plants and breathe from the submerged portion of plants. All mosquito larvae undergo three

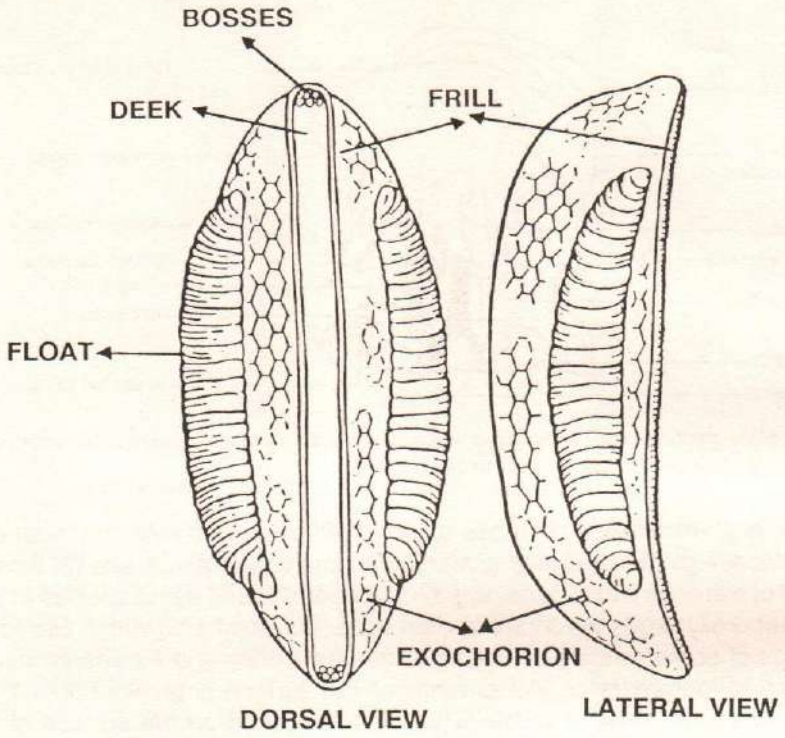


Figure 12: Egg of an anopheline mosquito (Reid, 1968).

successive moultings (ecdysis) during their development (7–10 days, depending upon the environmental factors) when they shed their chitinous skin. The successive moults are known as I, II, III, and IV instars or stages. The IV instar is a mature stage and with the fourth moult the pupa appears.

Generally, there are two types of larval movements: (1) by jerks of the body and by propulsion with mouth brushes, e.g., *Anopheles* and (2) by crawling, e.g., all other culicine larvae. The position of anopheline larvae is parallel to the water surface while culicine larvae hang head down with only the tip of the air tube penetrating the surface film (see Fig. 2).

The anopheline larvae are worm-like and the body of the "wrigglers" can be easily distinguished in three parts: head, thorax, and abdomen (Fig. 13). All these parts contain some important hairs or plates which are used in the identification of the species. The number and position of hairs are important characteristics. The head, which is cylindrical in shape and is covered with a chitinous sheet, consists of antennae in front and eyes lateral to it. The head contains a number of important hairs on the dorsal side (see Fig. 14).

The thorax is formed of pro-, meso-, and metathorax fused together and is thicker and broader than the head or abdomen and somewhat flattened. The thorax also has a number of hairs which are used in identification but there are no other special structures (Fig. 15).

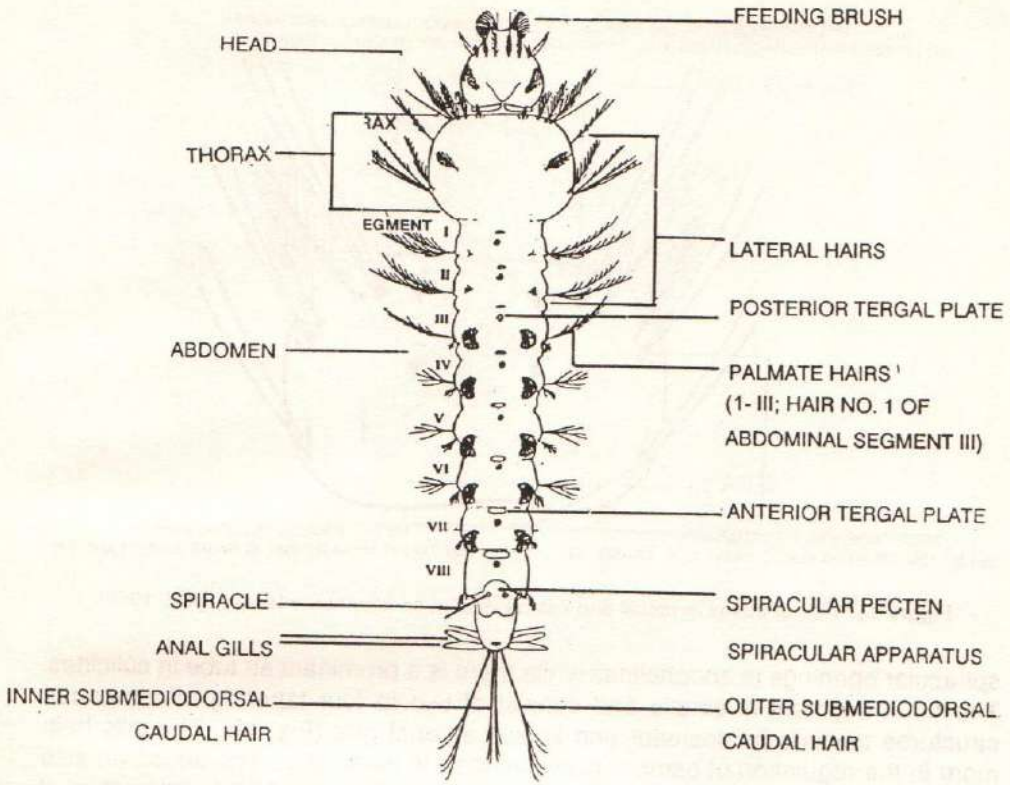


Figure 13: Generalized diagram of an anopheline larva (subgenus *Cellia*).

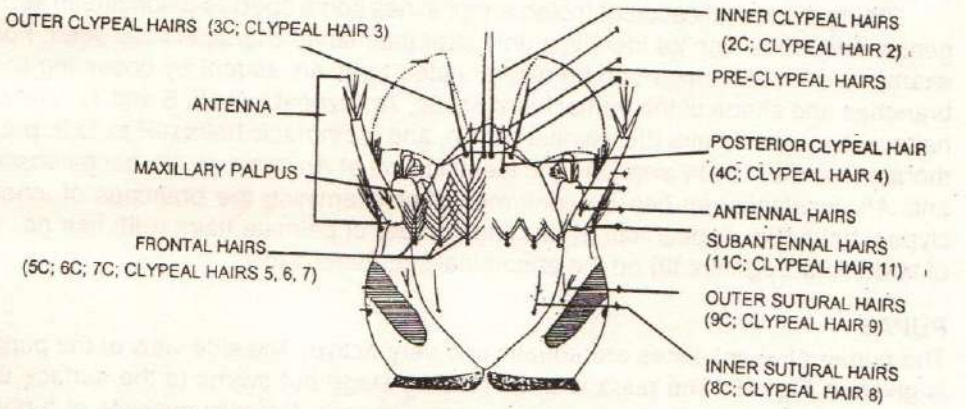


Figure 14: Head of an anopheline larva showing important hair in dorsal view (Puri, 1960).

The abdomen is long and sub-cylindrical and is composed of 10 segments. The structures of the first seven segments are similar but the eighth and ninth segments are considerably modified and form a complicated structure known as spiracular or respiratory apparatus. The respiratory apparatus consists of paired

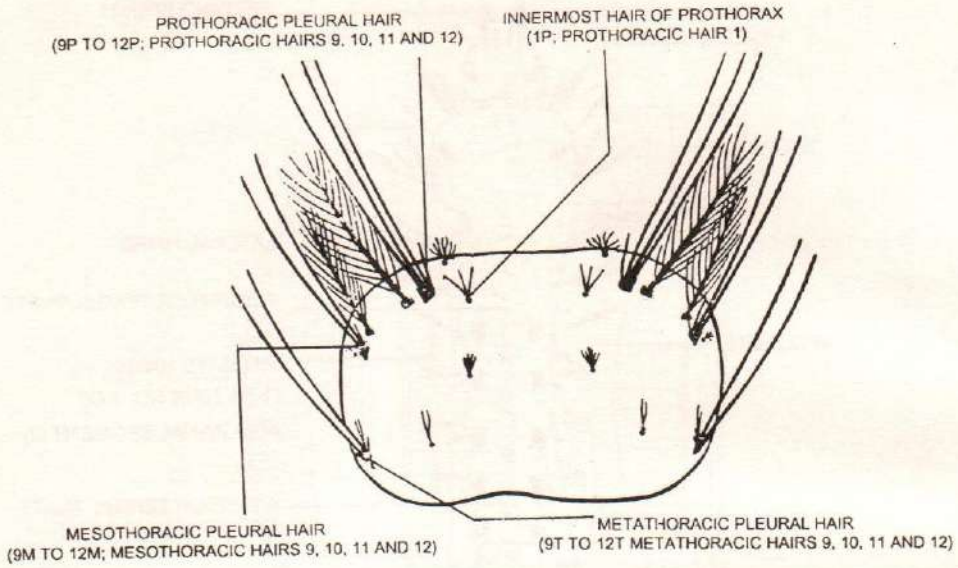


Figure 15: Hair of thorax in dorsal and ventral view of an anopheline larvan (Reid, 1968).

spiracular openings in anophelines while there is a prominent air tube in culicines. The tenth segment is simple and consist of two to four tapering membranous structures towards its posterior end known as anal gills (Fig. 13). The gills help more in the regulation of osmotic pressure than in respiration. The abdomen also consists of very important hairs and tergal plates which are the characterstics of a species.

During the identification of Indian anophelines some species belonging to subgenus *Anopheles* can be identified only after their larval characters are seen. For example, *An. culiciformis* can be differentiated from *An. sintoni* by observing the branches and shape of the frontal hairs(5c, 6c, 7c; clypeal hairs 5, 6 and 7), lateral hairs, subantennal hairs (IIc, clypeal hair II), and prothoracic hairs (9P to 12P; prothoracic hairs 9, 10, 11 and 12). The identification of *An. aitkenii, An. bengalensis*, and *An. insulaeflorum* can be confirmed after examining the branches of inner clypeal hairs (2c; clypeal hair 2) and the number of palmate hairs (I-III; hair no. 1 of abdominal segment III) on the abdominal segments 1 to 7.

PUPAE

The pupae of anophelines are aquatic and very active. The side view of the pupa is given in Fig. 16. The pupa is a nonfeeding stage but swims to the surface of the water to breathe. There is a large cephalothorax. Dorsally consists of a pair of trumpets and ventrally the developing mouth parts, eyes, legs, and wings of the adults. The abdomen consists of eight freely movable segments with a pair of paddles at the tip. The pupae move with considerable speed because of the vigorous movement of the abdomen.

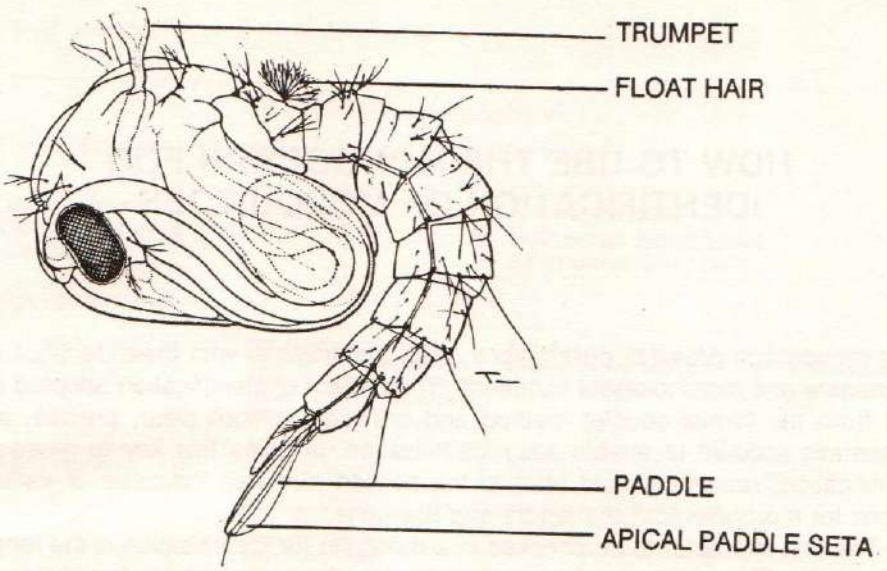


Figure 16: Pupa of an anopheline mosquito in side view (Reid, 1968).

HOW TO USE THE MONOGRAPH FOR IDENTIFICATION OF MOSQUITOES

This monograph provides descriptions of 58 anophelines with their identification characters and morphological variations. The pattern of identification adopted differs from the formal couplet method and provides a more clear, precise, and systematic account to enable easy identification. In using this key to mosquito identification, readers should refer to the section numbers indicated at various places for morphological characters and drawings.

The first character to be checked in a mosquito for identification is the length of the palpi. The palpi are of the same size as the proboscis in *Anopheles* (in females the palpi are rod-shaped, while in males they are club-shaped). The next step is the examination of the presence of the total number of pale areas on the costa, subcosta, and vein 1(R1) on the wings. If the number of pale areas is three or less and the wing is completely dark, the specimen belongs to the subgenus *Anopheles*; if the number of pale areas is four or more it belongs to subgenus *Cellia*. For further identification up to the species level, flow charts (Tables 6 and 7) and diagrams are given for the subgenara *Anopheles* and *Cellia*. A total number of 34 species belonging to the subgenus *Cellia* is divided into four groups on the basis of palpi ornamentation, and using the morphological features, these groups are further divided.

Twenty-four species of the subgenus *Anopheles* are divided into two main groups on the basis of the presence or absence of pale areas on the wings. In one group the wing is completely dark and in the other it has pale areas. The group with a completely dark wing is divided into two groups which are further grouped into subgroups and finally to the species. The group comprising spotted wings is divided into three groups on the basis of palpi ornamentation and further divided into smaller subgroups leading to species identification. For confirmation of a particular species additional morphological features are given.

For each species the monograph provides a full diagram with main identification characters, name, its derivative, type form available, brief biology, status of insecticide resistance, reported distribution in India and in the world, vector incrimination, and the morphological variations. It contains 209 diagrams of the head, wing, leg, thorax and abdomen, 58 full diagrams, one for each of the species, and 189 illustrations of morphological variations (belonging to 24 species).

Mosquito identification is generally based on female morphological features, but in the case of subgroups, viz. *An. bengalensis, An. culiciformis, An. aitkenii, An. insulaeflorum*, of the subgenus *Anopheles*, identification is based on larval characters. The identification of *An. pinjaurensis* is based on the male genitalia.

Table 6: Identification of 58 Indian Anophelines

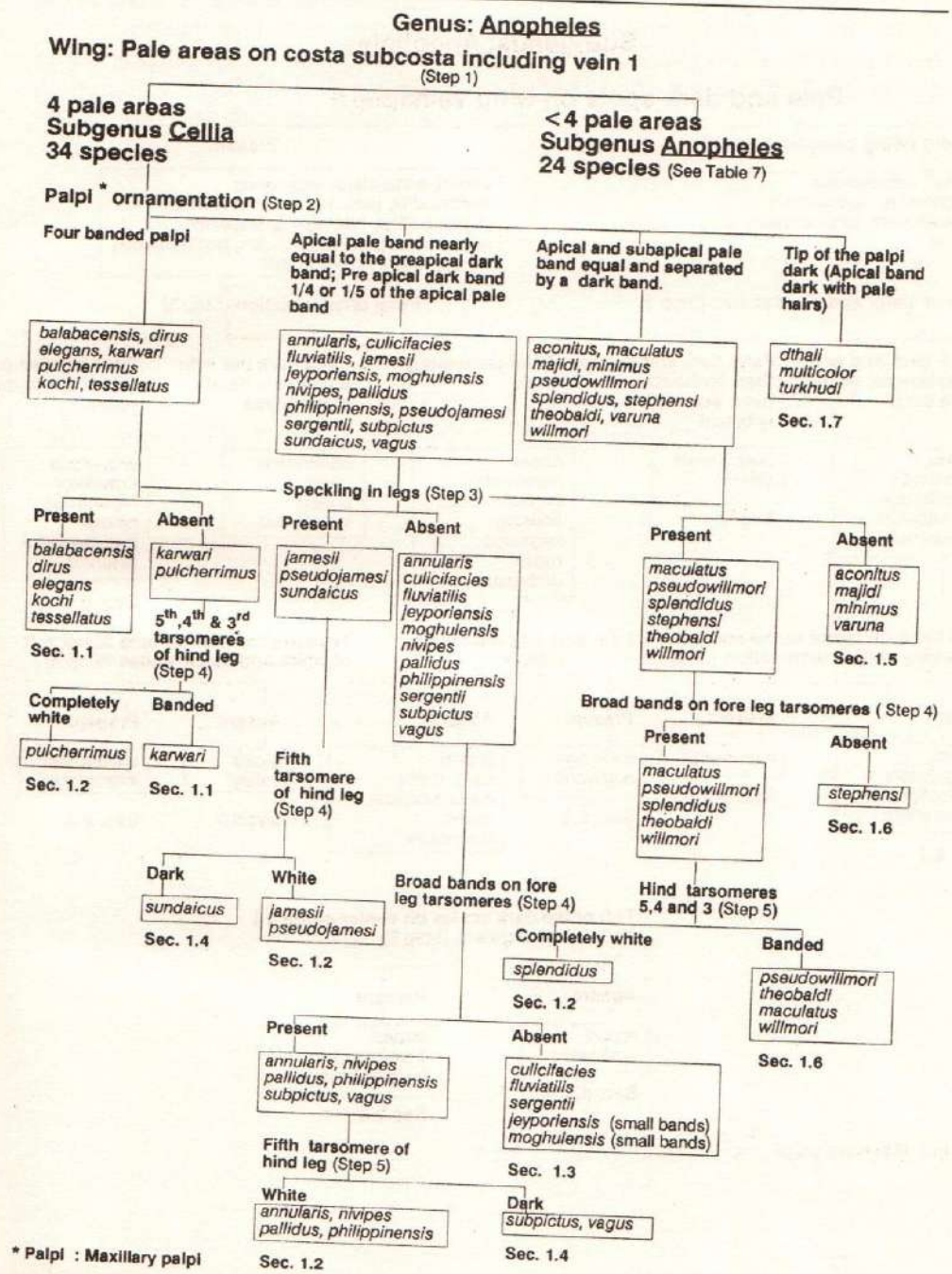
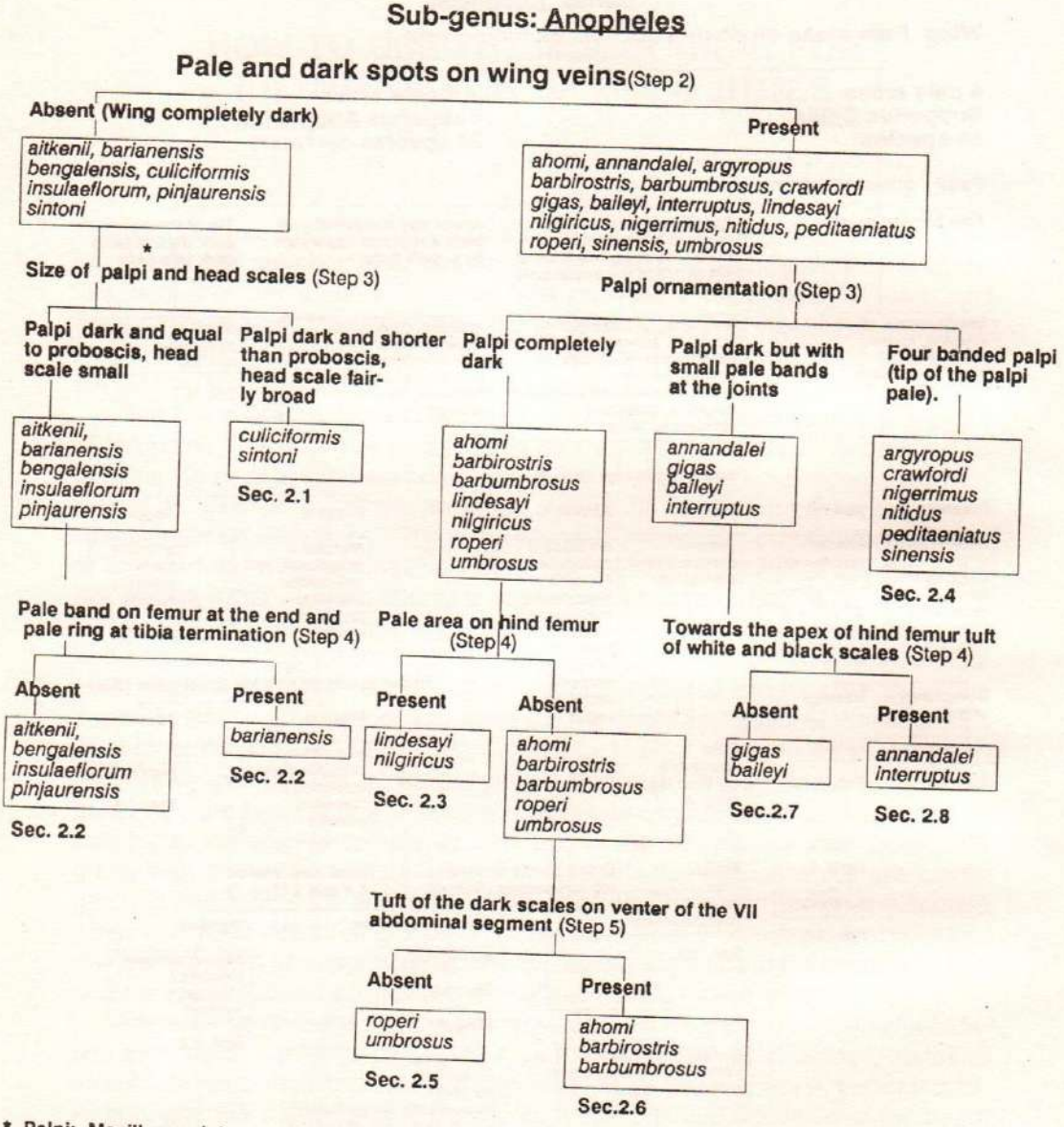


Table 7: Identification of 24 species of subgenus Anopheles

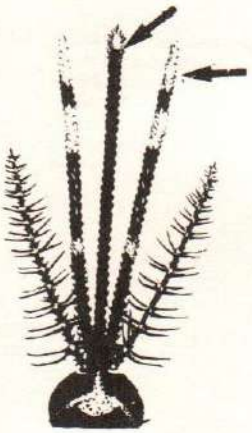


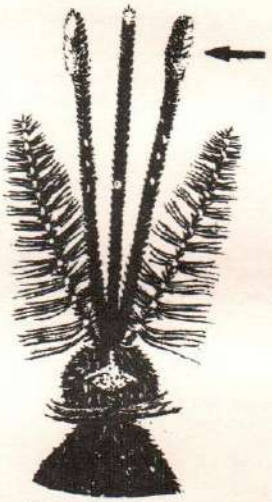
* Palpi: Maxillary palpi

Full drawings of 35 Indian anophelines have been prepared with the help of a brush and Indian ink after measuring their size under a dissecting microscope with an occulometer and stage meter. The 35 species are available in the museum of the Malaria Research Centre. The other 23 anopheline drawings have been prepared by modifying their closely related species with the help of Christophers (1933), Reid (1968) and Harrison and Scanlon (1975).

GENUS ANOPHELES

PALPI LONG, SLENDER (IN FEMALES) OR CLUB-SHAPED (IN MALES) AND EQUAL TO THE PROBOSCIS



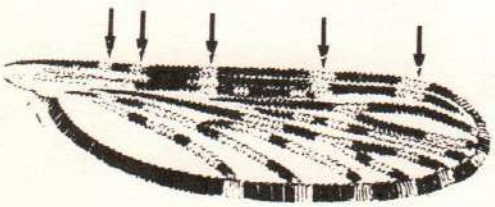


Genus *Anopheles* comprises subgenera *Anopheles, Cellia, Kerteszia, Lophopodomyia, Nyssorhynchus*, and *Stethomyia*. In India only subgenera *Anopheles* and *Cellia* are recorded.

SUBGENUS IDENTIFICATION IS BASED ON WING CHARACTERS. EXAMINE EACH SPECIMEN IN THE FOLLOWING ORDER

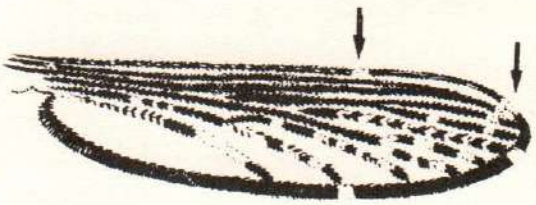
SUBGENUS *CELLIA*

Costa, subcosta including vein 1(R1) with 4 or more pale areas



SUBGENUS *ANOPHELES*

Costa, subcosta including vein 1(R1) with 3 or less pale areas



Species in Subgenus *Cellia*

An. aconitus, An. annularis, An. balabacensis, An. culicifacies, An. dirus, An. dthali, An. elegans, An. fluviatilis, An. jamesii, An. jeyporiensis, An. karwari, An. kochi, An. maculatus, An. majidi, An. minimus, An. moghulensis, An. multicolor, An. nivipes, An. pallidus, An. pseudojamesi, An. pseudowillmori, An. pulcherrimus An. philippinensis, An. sergentii, An. splendidus, An. stephensi, An. subpictus, An. sundaicus, An. tessellatus, An. theobaldi, An. turkhudi, An. vagus, An. varuna, An. willmori

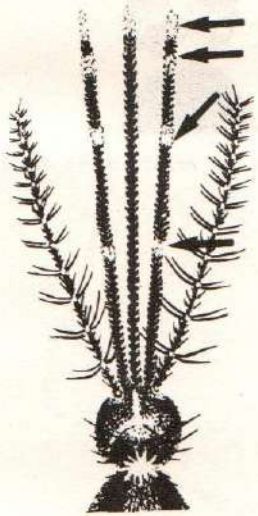
Species in subgenus *Anopheles*

An. ahomi, An. aitkenii, An. annandalei, An. argyropus, An. baileyi, An. barianensis, An. barbirostris, An. barbumbrosus, An. bengalensis, An. crawfordi, An. culiciformis, An. gigas, An. insulaeflorum, An. interruptus, An. lindesayi, An. nigerrimus, An. nilgiricus, An. nitidus, An. peditaeniatus, An. pinjaurensis, An. roperi, An. sinensis, An. sintoni, An. umbrosus

1. Subgenus *Cellia*

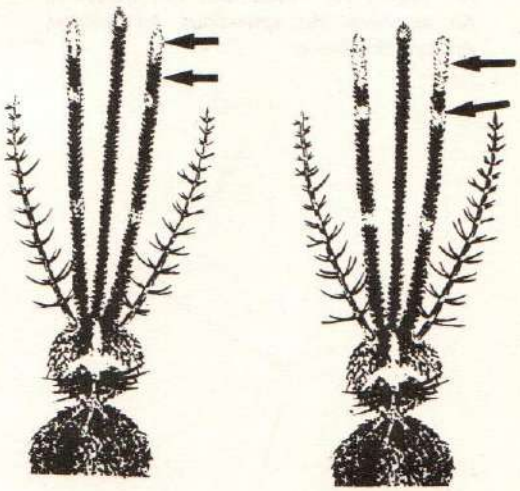
IDENTIFICATION IS BASED ON PALPI ORNAMENTATION

Four-banded palpi



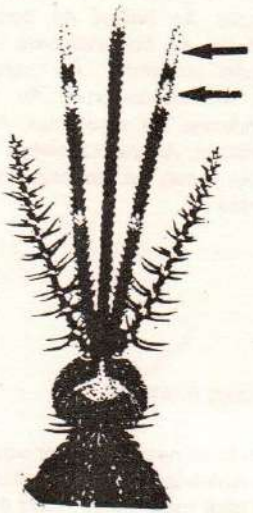
An. kochi, An. karwari, An. tessellatus, An. balabacensis, An. dirus, An. elegans, An. pulcherrimus

Apical pale band nearly equal or equal to the pre-apical dark band (intervening dark band); pre-apical dark band 1/4 or 1/5 of the apical pale band.



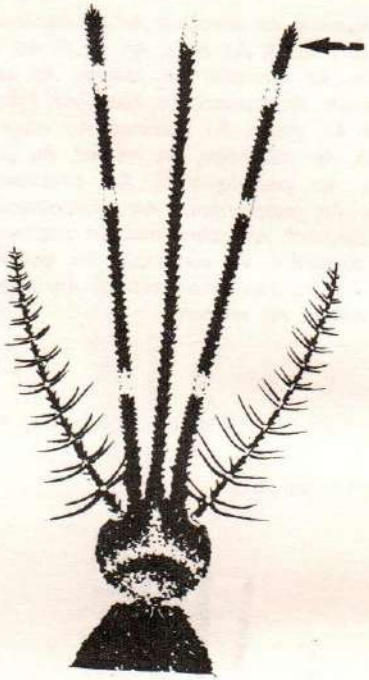
An. culicifacies, An. fluviatilis, An. sergentii, An. moghulensis, An. jeyporiensis, An. subpictus, An. vagus, An.sundaicus, An. annularis, An. pallidus, An. philippinensis, An. nivipes, An. jamesii, An. pseudojamesi

Apical and subapical pale band equal and separated by a small or same-sized dark band



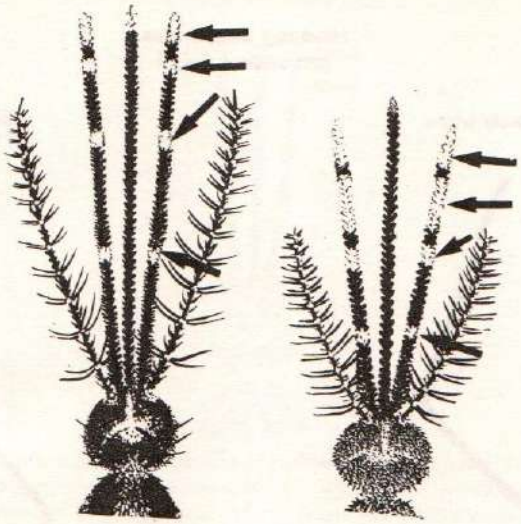
An. minimus, An. varuna, An. aconitus, An. majidi, An. maculatus, An. theobaldi, An. stephensi, An. splendidus, An. willmori, An. pseudowillmori

Tip of palpi dark



An. turkhudi, An. multicolor, An. dthali (Sec. 1.7)

Four-banded palpi



An. kochi, An. karwari, An. tessellatus,
An. balabacensis, An. dirus, An. elegans
An. pulcherrimus

Speckling in legs

Present

An. kochi, An. elegans, An. tessellatus
An. dirus, An. balabacensis (Sec. 1.1)

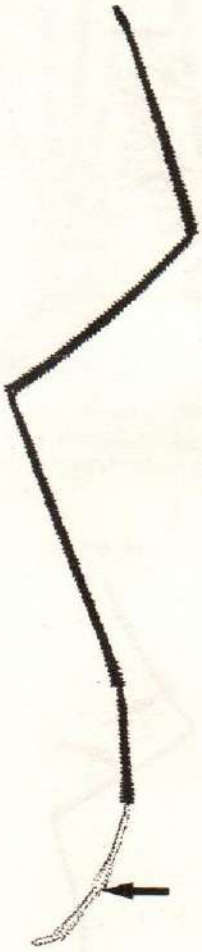
Absent

An. karwari, An. pulcherrimus

An. pulcherrimus, An. karwari

Hind-leg tarsomeres
(tarsomeres 5,4,3)

Completely white

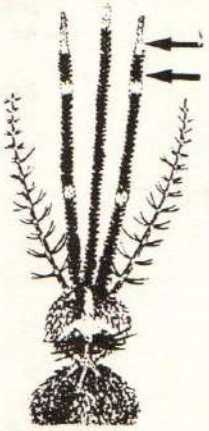


An. pulcherrimus (Sec. 1.2)

Banded

An. karwari (Sec. 1.1)

Apical pale band nearly equal or equal to the pre-apical dark band (intervening dark band); pre-apical dark band 1/4 or 1/5 of the apical pale band



An. culicifacies, An. fluviatilis, An. sergentii, An. moghulensis, An. jeyporiensis, An. subpictus, An. vagus, An. sundaicus, An. nivipes, An. annularis, An. pallidus, An. philippinensis, An. jamesii, An. pseudojamesi

Speckling in legs

Present

An. sundaicus, An. jamesii, An. pseudojamesi

Absent

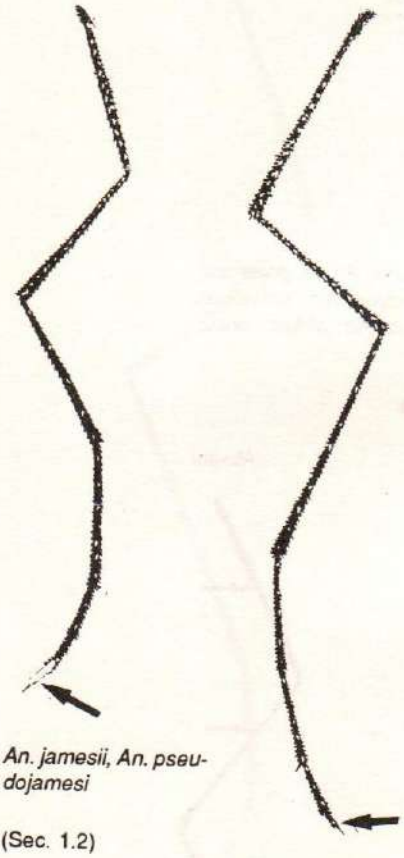
An. culicifacies, An. fluviatilis, An. sergentii An. moghulensis, An. jeyporiensis, An. subpictus, An. vagus, An. annularis, An. pallidus, An. philippinensis, An. nivipes

An. sundaicus, An. jamesii, An. pseudojamesi

Fifth tarsomere of hind-leg

White

Dark



An. jamesii, An. pseudojamesi

(Sec. 1.2)

An. sundaicus

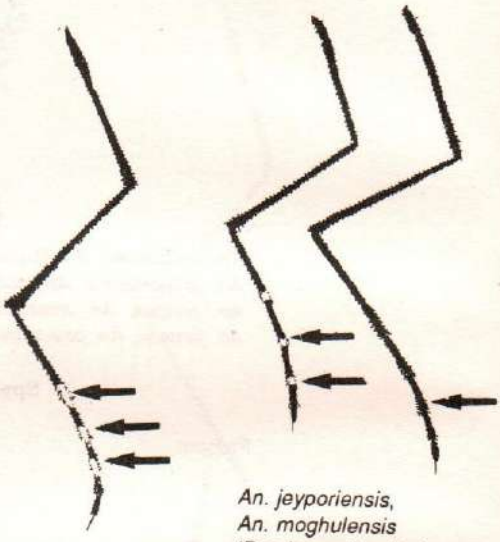
(Sec. 1.4.)

An. culicifacies, An. fluviatilis, An. sergentii, An. moghulensis, An. jeyporiensis, An. subpictus, An. vagus, An. annularis, An. pallidus, An. philippinensis, An. nivipes

Bands on foreleg tarsomeres

Present

Absent



An. subpictus,
An. vagus,
An. annularis,
An. pallidus,
An. nivipes,
An. philippinensis

An. jeyporiensis,
An. moghulensis
(Bands small in size),
An. culicifacies,
An. fluviatilis,
An. sergentii

(Sec. 1.3)

An. subpictus, An. vagus, An. annularis,
An. pallidus, An. philippinensis, An. nivipes

Fifth tarsomeres of hind leg

White
(tarsomeres 5,4,3)
completely white

An. annularis, An. pallidus,
An. philippinensis, An. nivipes

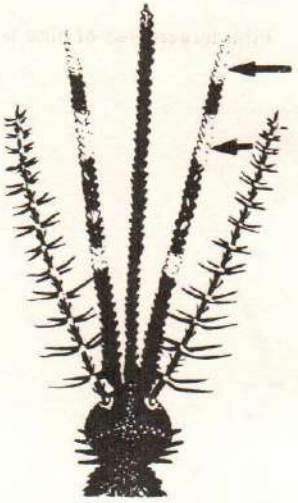
(Sec. 1.2)

Dark

An. subpictus, An. vagus

(Sec. 1.4)

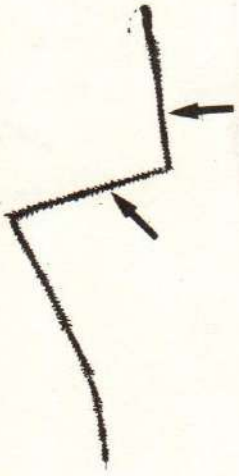
Apical and subapical pale band equal and separated by a small or same-sized dark band



An. minimus, An. varuna, An. aconitus, An. majidi, An. maculatus, An. theobaldi, An. stephensi, An. splendidus, An. willmori, An. pseudowillmori

Speckling in legs

Absent



An. minimus, An. varuna, An. aconitus, An. majidi

Present

An. maculatus, An. theobaldi, An. willmori, An. pseudowillmori, An. splendidus, An. stephensi

An. minimus, An. varuna, An. aconitus
An. majidi

Bands on foreleg tarsomeres

Absent

An. minimus,
An. varuna,
An. aconitus

(Sec. 1.5)

Present

An. majidi

(Sec. 1.5)

An. maculatus, An. theobaldi, An. willmori, An. pseudowillmori, An. splendidus, An. stephensi

Bands on foreleg tarsomeres

Absent

An. stephensi

(Sec. 1.6)

Present

An. maculatus,
An. theobaldi,
An. willmori,
An. pseudowillmori,
An. splendidus

An. maculatus, An. theobaldi, An. willmori
An. pseudowillmori, An. splendidus

Hind-leg tarsomeres
(tarsomeres 5,4,3)

Completely white

An. splendidus (Sec.1.2)

Banded

An. maculatus,
An. theobaldi,
An. willmori,
An. pseudowillmori

(Sec. 1.6)

1.1 An. kochi, An. balabacensis, An. dirus, An. elegans, An. karwari, An. tessellatus, An. pulcherrimus

Wing with 4 or more pale areas on the costa, subcosta including vein 1 (R-1)

Four-banded palpi

A big white spot on the junction of tibiotarsal joint of hind leg

Present

An. balabacensis, An. dirus, An. elegans

Absent

*An. tessellatus, An. kochi, An. karwari, An. pulcherrimus**

Other characters

Legs with speckling. Foreleg tarsomeres with broad pale bands

Speckling on legs

Present

An. tessellatus, An. kochi

Absent

An. karwari

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* Further identification is given in Sec. 1.2

An. balabacensis, An. dirus, An. elegans

Other characters

Wing vein 6(Anal) with more than 6 dark spots and similar spots on veins 5(Cu) and 5.1(Cu1)

Fringe spot absent on veins 6(Anal) and 5(Cu) but present between these two veins.

An. balabacensis, An. dirus, An. elegans

Length of the proboscis

Proboscis quite long, longer than fore-femur

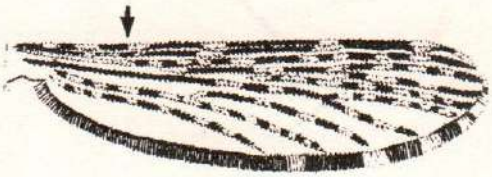
Other characters

Pre-sector dark spot of vein 1(R1) completely dark

Proboscis normal in size (nearly equal to fore-femur)

Other characters

Pre-sector dark spot of vein 1(R1) with pale interruption



Apical pale band of hind tibia with longitudinal dark strip on ventral side

An. elegans

Apical pale band of hind tibia without any longitudinal dark strip

An. balabacensis, An. dirus

Wing vein 1(R1)

Pre-sector dark mark of vein 1(R1) extended basally beyond the end of the corresponding marking on the costa, but not reaching up to the distal end of humeral dark spot

An. balabacensis

Pre-sector dark mark of vein 1(R1) extending basally beyond the distal end of the humeral dark mark on the costa

An. dirus

An. tessellatus, An. kochi

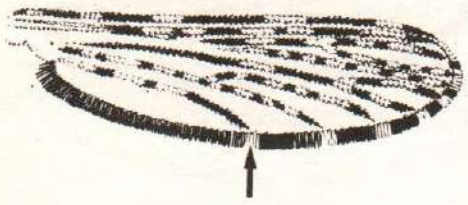
Banding on hind-leg tarsomeres

Narrowly banded

Other characters

Apical half of proboscis yellow

Wing as in *An. dirus* but fringe spot present on vein 6(Anal)



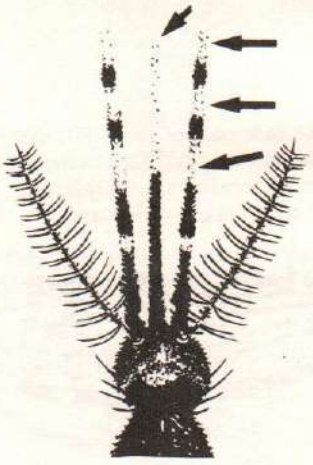
An. tessellatus

Narrowly banded but remaining joints with broad pale bands

An. kochi

Other characters

Apical 3 broad pale bands separated by 2 small dark bands; apical half of proboscis yellow

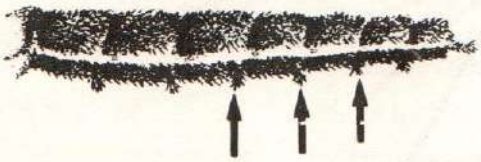


Other characters

An. kochi

Vein 6(Anal) with three small dark areas and inner costa interrupted

Venter of the abdomen with prominent tuft of black scales on each segment e.g., from 2 to 7

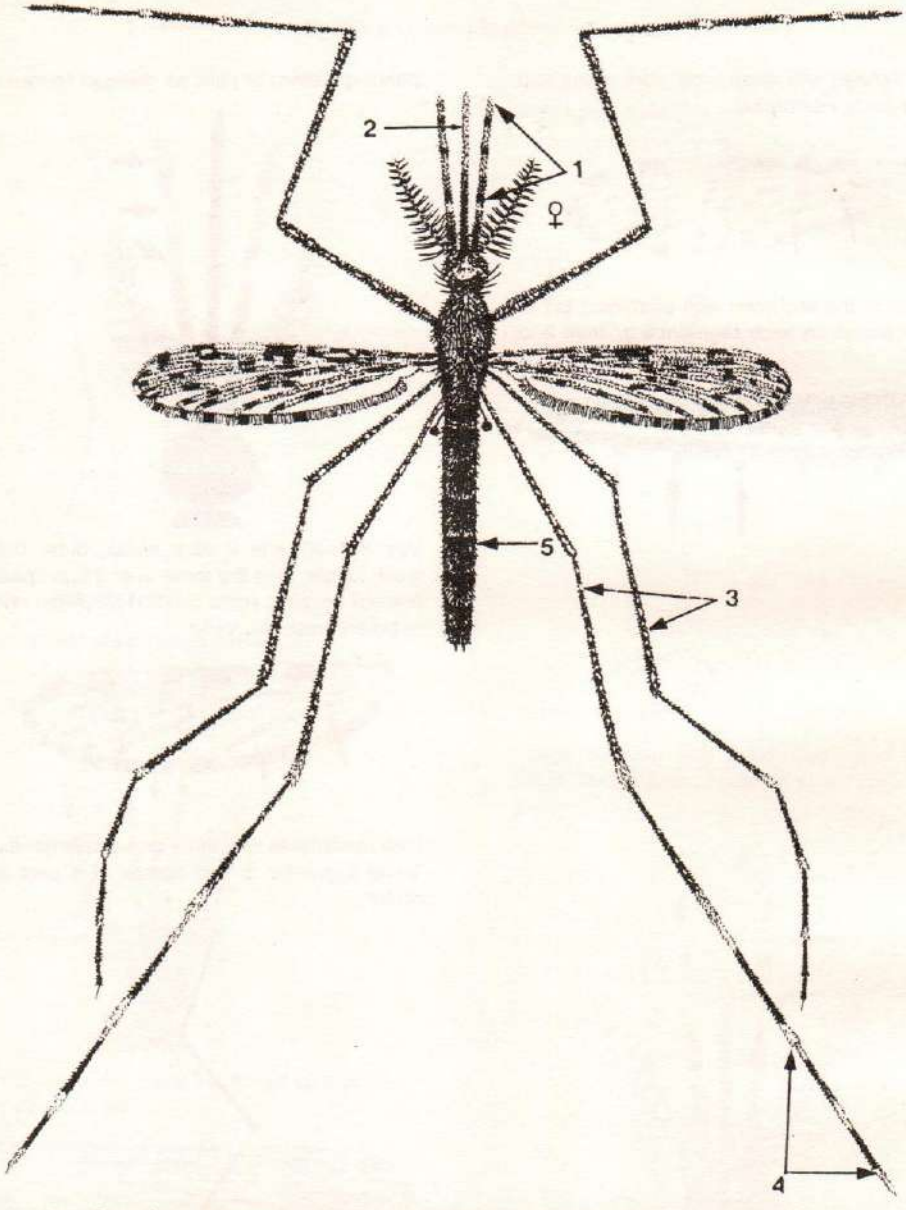


An. karwari

Banding pattern of palpi as given in figure

Vein 6(Anal) with 2 dark areas; outer half much longer than the inner one; fringe spots present on wing veins 5.1(Cu1), 6(Anal) and between these two veins

Hind tarsomeres with three broad pale bands. Tarsal segments 5 and portion of 4 pale in colour



An. kochi Doenitz 1901, main identification characters

1. Four banded palpi.
2. Half of the proboscis yellow in colour.
3. Legs with speckling.
4. Hind leg tarsomeres banded as shown in figure.
5. Venter of the abdomen with tuft of black scales.

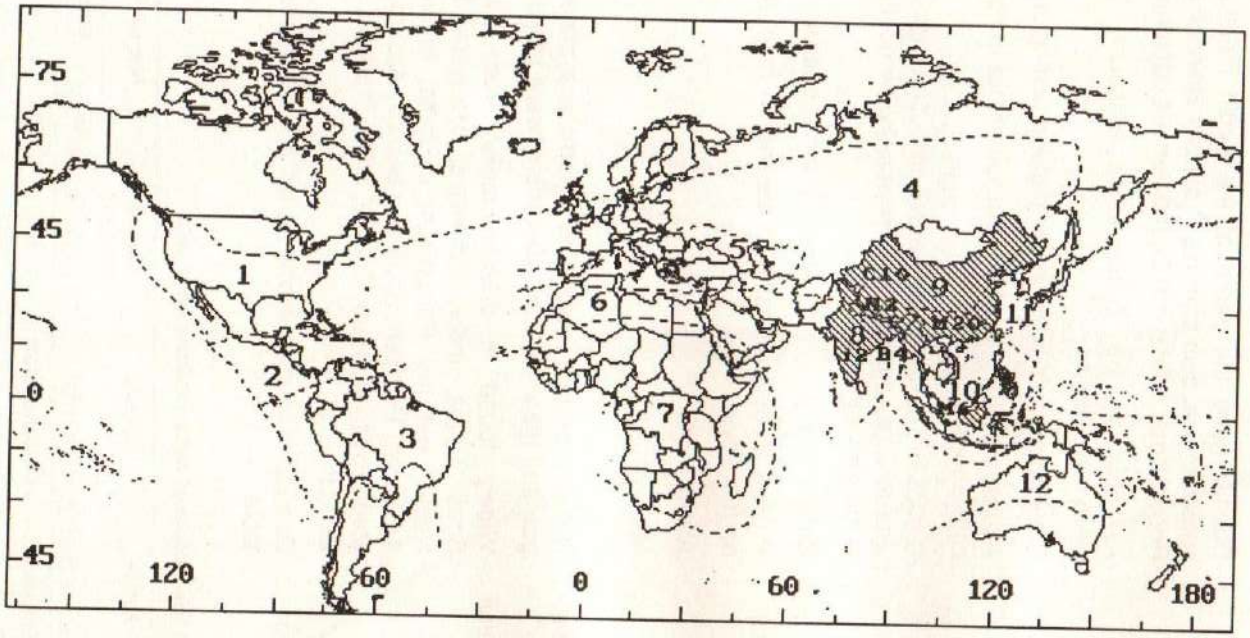
Anopheles kochi

Name	:	*An. kochi* Doenitz, 1901. *Insektenborse* **18**: 36–38.
Derivative	:	Doenitz gave the name at the Berlin meeting of the entomological club after his Professor Heinrich Hermann Robert Koch (1843–1910), the famous bacteriologist.
Type form	:	Available at the Zoologisches Museum, Humboldt University, Berlin.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Adults rest mainly outdoors but sometimes in houses and cattlesheds also.
Breeding ecology	:	Breeds in shallow,muddy water collections, ground pools with or without grass, hoof marks, fallow ricefields, also in streams of jungles.
Biting time	:	Before midnight, preferably in the first quarter.
Feeding preference	:	Prefers feeding on cattle to feeding on man. Also feeds on monkeys.
Flight range	:	About 1 km.
Susceptibility to insecticides	:	NA
Relation to disease	:	Not an important vector of human malaria, although some gut- and gland-infected specimens were found in India.
Reported distribution	:	Widely found in oriental region from Bangladesh, South China, India, Indonesia, Malaysia, Myanmar, Nepal, and the Philippines. In India, recorded from Arunachal Pradesh, Andaman Islands, Assam, Manipur, Meghalaya, Mizoram, Tripura, Uttar Pradesh, and West Bengal.
Vector incrimination	:	Results of studies made so far are summarized in the table.

Table : *Anopheles kochi*: Results of vector incrimination studies

Sl. No.	Year	Author	Locality	Number dissected	Number Positive		
					Gut	Gland	Total
1.	1929	Strickland	Cachar, Assam	535	1	0	1
2.	1930	Ramsay	Assam	2094	2	0	2
3.	1933	Manson & Ramsay	Jorhat, Assam	NM	1	0	1

NM—Not mentioned.



Reported distribution of *An. kochi* in the World.

ANDAMAN NICOBAR ISLANDS (A&N)
1 Andaman Islands

ARUNACHAL PRADESH (ARP)
1. Subansiri
2. Changlong
3. Tirap

ASSAM (ASS)
1. Kamrup
2. Nalabari
3. Kachugaon
4. Goalpara
5. Dibrugarh
6. Cachar

MANIPUR (MAN)
1 Manipur

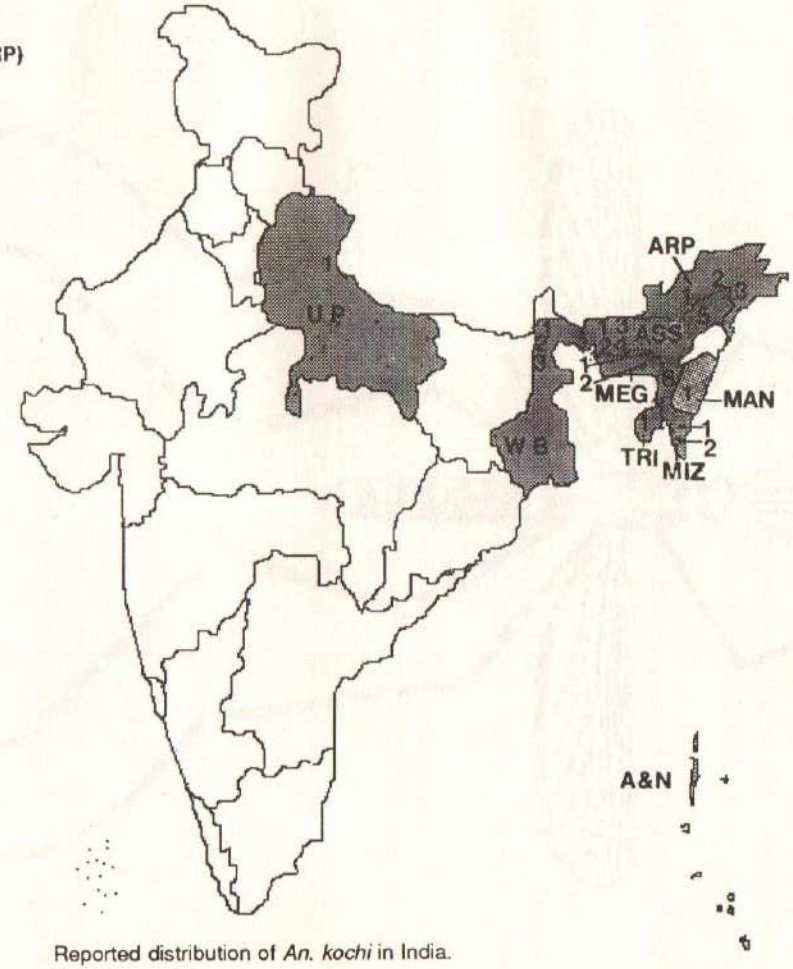
MEGHALAYA (MEG)
1. Burnihat
2. Shillong

MIZORAM (MIZ)
1. Aizwal
2. Demagiri

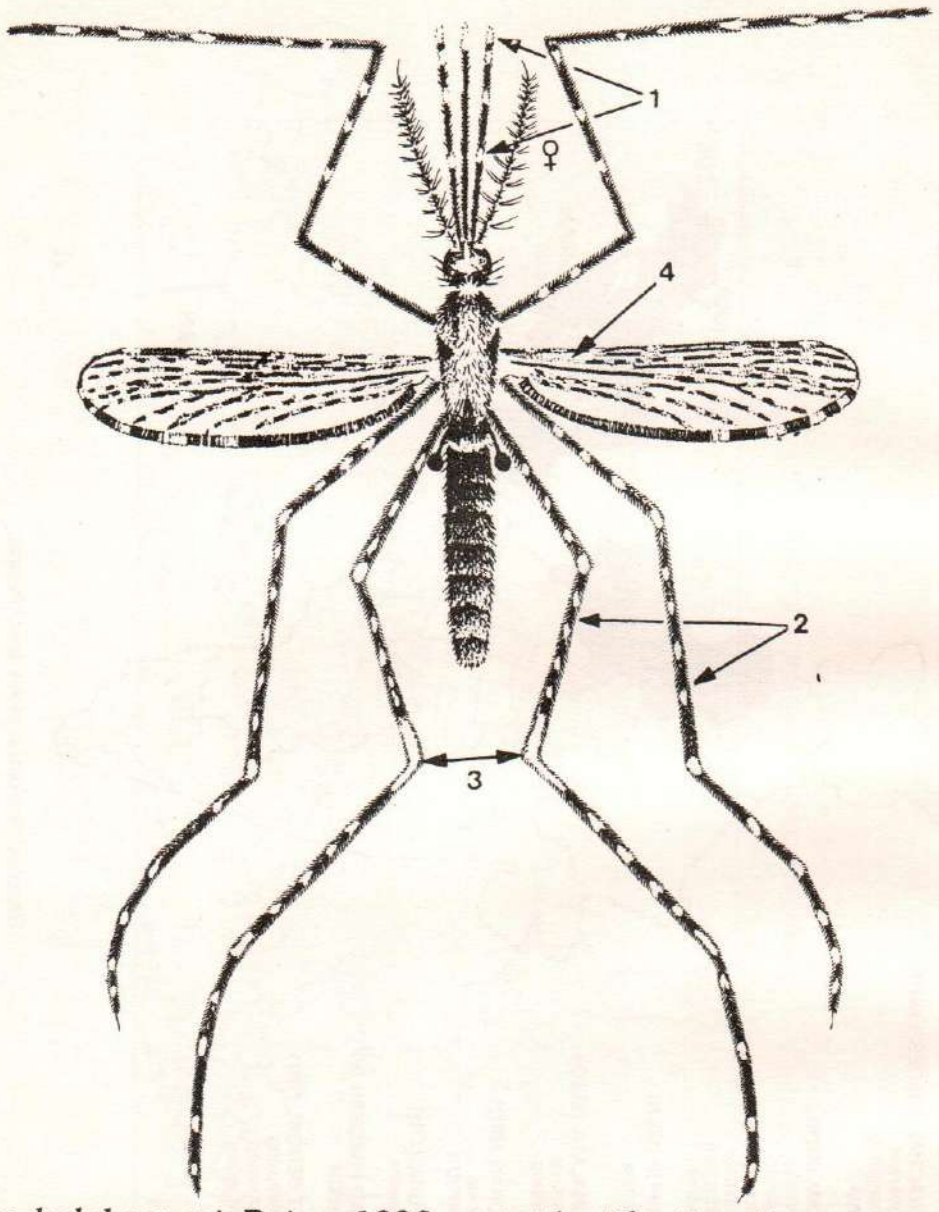
TRIPURA (TRI)
1. Agartala

UTTAR PRADESH (UP)
1. Nainital

WEST BENGAL (WB)
1. Kalimpong
2. Darjeeling
3. Kurseong



Reported distribution of *An. kochi* in India.

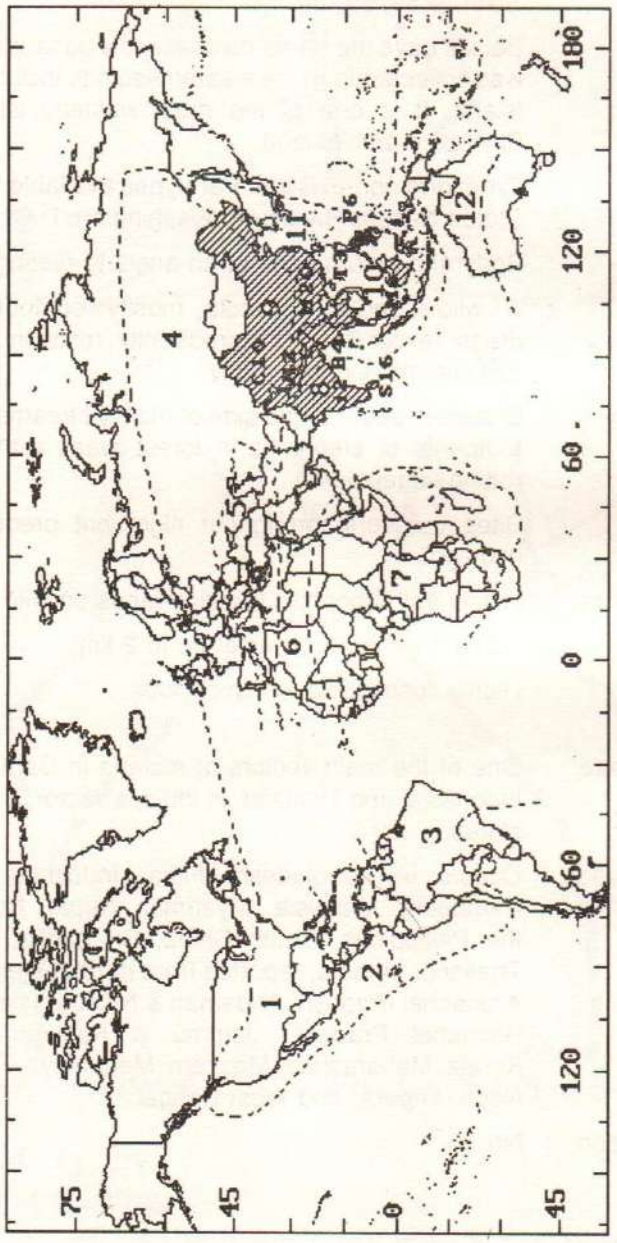


An. balabacensis Baisas 1936, main identification characters

1. Four banded palpi.
2. Legs with speckling.
3. A big white spot at the junction of femur and tibia of hind leg.
4. Pre-sector dark mark on vein 1 (R1) not extending basally up to humeral dark mark of costa.

Anopheles balabacensis

Name	:	*An. balabacensis* Baisas, 1936. *The Philippine Journal of Science* **59**: 65–84.
Derivative	:	Baisas gave the name *balabacensis* because the species was collected from the western islands including Balabac Island. It is one of the most westerly islands in the Philippine archipelago.
Type form	:	Type form non-existent. Paratypes available at the United States National Museum, Washington, D.C., USA.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	A wild species, it rests mostly outdoors in forest areas (exophilic) but infrequently rests in houses and cattlesheds during the day.
Breeding ecology	:	Breeds in pools by the side of mainly streams, borrowpits, footprints of elephants in forest areas with shade and rotting vegetations.
Biting time	:	Bites outdoors throughout night but predominantly at midnight.
Feeding preference	:	Highly anthropophilic but also feeds on wild animals.
Flight range	:	About 1 km and dispersal up to 2 km.
Susceptibility to insecticides	:	Highly susceptible to insecticides.
Relation to disease	:	One of the main vectors of malaria in Cambodia, India, Indonesia, and Thailand. In India, a vector in northeastern states.
Reported distribution	:	Occurs in Bangladesh, India, Indochina, Indonesia, Cambodia, Malaysia, Myanmar, Nepal, North Borneo, the Philippines, South China, Sri Lanka, Taiwan and Thailand. In India, reported from northeastern states and Arunachal Pradesh, Andaman & Nicobar Islands, Assam, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Maharashtra, Mizoram, Meghalaya, Punjab, Tamil Nadu, Tripura, and West Bengal.
Vector incrimination	:	NA



Reported distribution of *An. balabacensis* in the World.

ANDAMAN NICOBAR ISLANDS (A&N)
1. Andaman Islands

ARUNACHAL PRADESH (ARP)
1. Tirap

ASSAM (ASS)
1. Kachugaon
2. Goalpara
3. Cachar

HIMACHAL PRADESH (HP)
1. Shimla

JAMMU & KASHMIR (J&K)
1. Foothill areas

KARNATAKA (KAR)
1. Shimoga
2. Bijapur
3. Chitradurga
4. Hassan
5. Kanara
6. North Kanara
7. Kadur
8. Mysore
9. Coorg

KERALA (KER)
1. Wynaad

MAHARASHTRA (MAH)
1. Western Ghats

MIZORAM (MIZ)
1. Aizwal

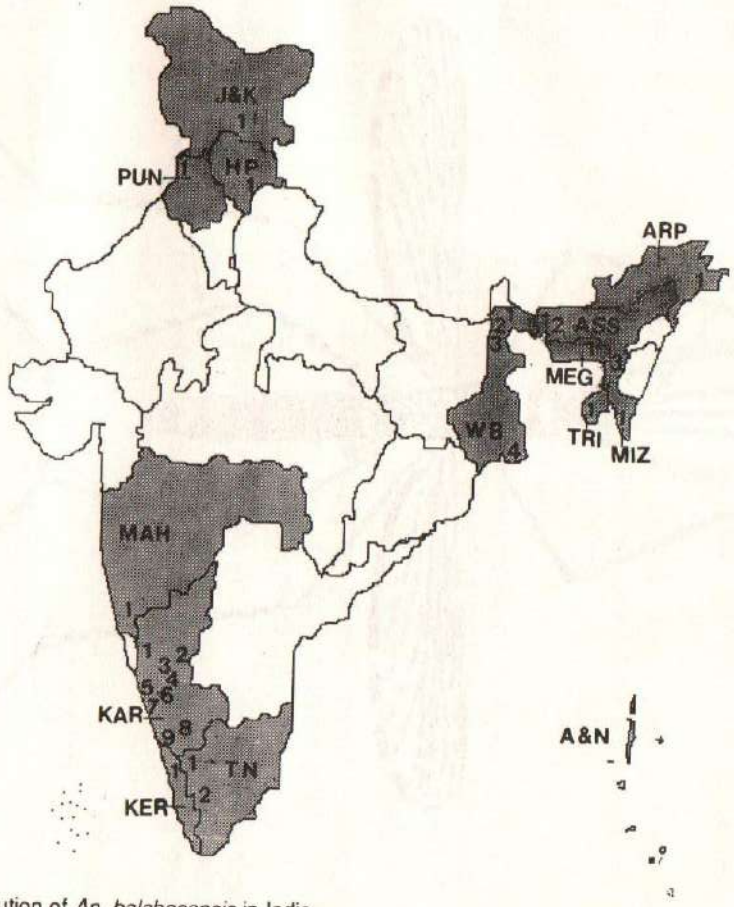
MEGHALAYA (MEG)
1. Burnihat

PUNJAB (PUN)
1. Gurdaspur

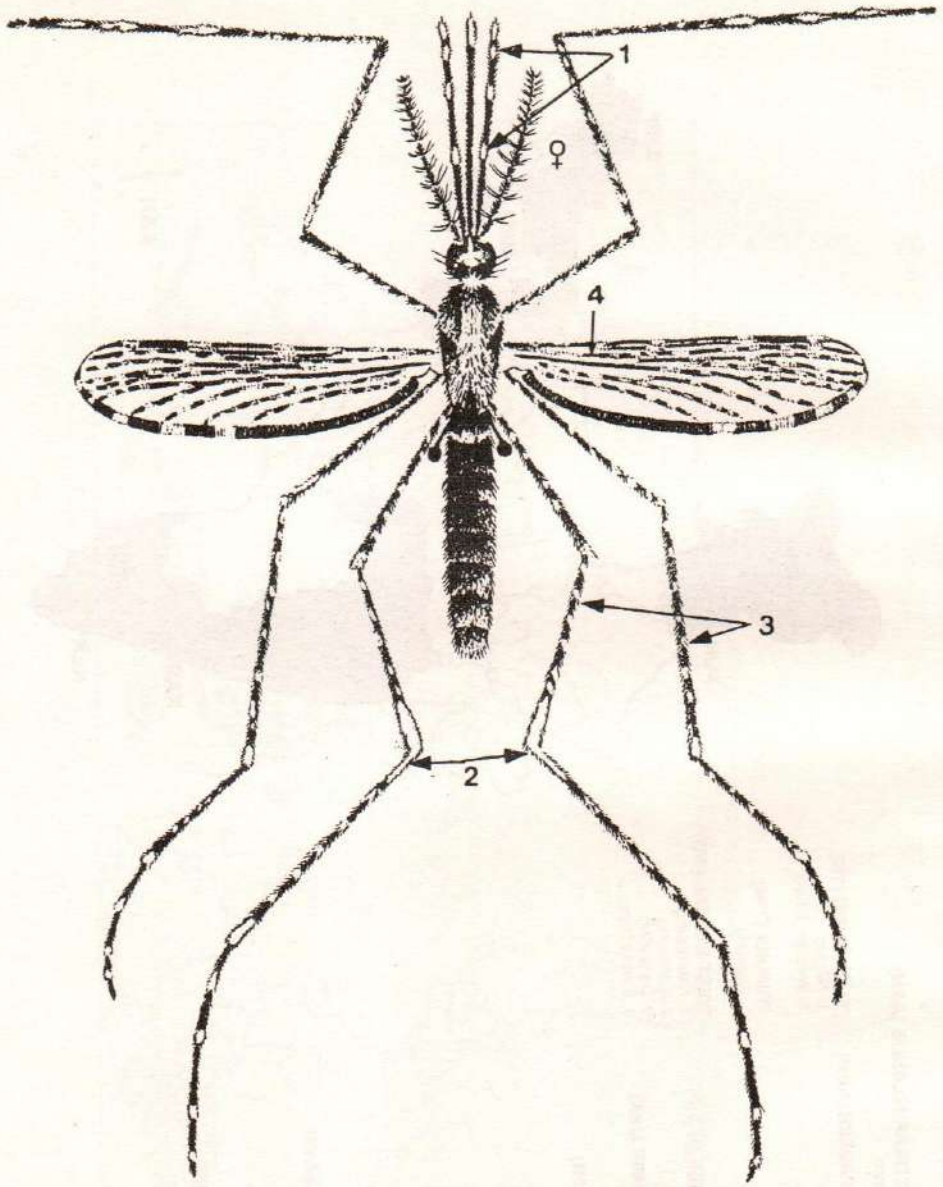
TAMIL NADU (TN)
1. Nilgiris
2. Western Ghats

TRIPURA (TRI)
1. Agartala

WEST BENGAL (WB)
1. Kalimpong
2. Kurseong
3. Darjeeling
4. Sundarbans



Reported distribution of *An. balabacensis* in India.



An. dirus Peyton & Harrison 1979, main identification characters

1. Four banded palpi.
2. A big white spot at the junction of femur and tibia of hind leg.
3. Legs with speckling.
4. Pre-sector dark mark on vein 1 (RI) basally extended up to humeral dark mark of costa.

*Anopheles dirus**

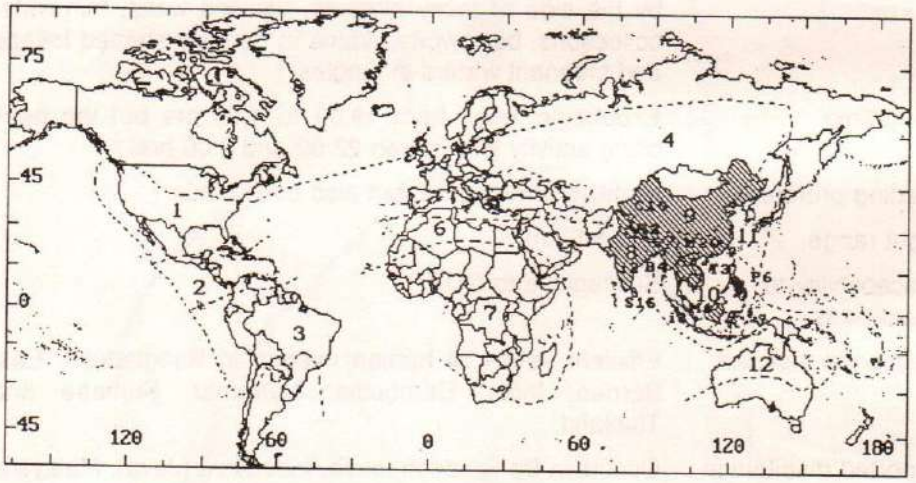
Name	:	*An. dirus Peyton and Harrison, 1979. Mosquito Systematics* **11**: 40–49.
Derivative	:	Latin, *dirus*, fearful, horrible, dire. Peyton and Harrison chose the name *dirus* to reflect high vector efficacy in the transmission of malaria.
Type form	:	Location not known.
Species complex	:	Seven sibling species (known as A, B, C, D, E, F and takasagoensis); species E is only recorded from western India, all other species are recorded from Thailand.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Wild species, infrequently present inside houses and cattlesheds during day. Adults can be collected at night on human and cattle bait collections.
Breeding ecology	:	A pool breeder in dense jungles. Also breeds in pools by the side of rocky streams, disused wells, rain-water collections, borrowpits, drains in densely-shaded foliage and stagnant waters in jungles.
Biting time	:	Exophagic, bites from 19.00 to 4.00 hrs but the peak biting activity is between 22.00 and 2.00 hrs.
Feeding preference	:	Highly anthropophilic but also bites cattle.
Flight range	:	1 to 1.5 km.
Susceptibility to insecticides	:	Susceptible to DDT.
Relation to disease	:	Efficient vector of human malaria in Bangladesh, East Borneo, India, Cambodia, Myanmar, Sumatra and Thailand.
Reported distribution	:	Occurs in Bangladesh, India, Indonesia (Java), Malaysia, North Myanmar, Myanmar, and Thailand. In India, recorded from Arunachal Pradesh, Andaman Islands, Assam, Karnataka, Kerala, Meghalaya, Mizoram, Tamil Nadu, Tripura, and West Bengal.
Vector incrimination	:	Results of studies made so far are summarized in the table.

*In India previously it was misidentified as *An. balabacensis* but recent studies show that the species is *An. dirus*.

Table : *Anopheles balabacensis**: Results of vector incrimination studies

Sl. No.	Year	Author	Locality	Number dissected	Number Positive		
					Gut	Gland	Total
1.	1941	Clark & Choudhury	Digboi area, Assam	859	8	21	29
2.	1948	Macan	Assam	92	—	—	1
3.	1973	Sen *et al.*	Tirap, Arunachal Pradesh	1811	0	3	3
4.	1984	Annual Report, NMEP	Boko, Assam	199	0	1	1
5.	1985	Das and Baruah	Mizoram	134	0	1	1
6.	1989	Dutta *et al.*	Dibrugarh, Assam	74	0	1	1
7.	1989	Dutta *et al.*	Changlang, Arunachal Pradesh	609	0	7	7
8.	1990	Das *et al.*	Tlabong, South Mizoram	178	0	2	2

* Now identified as *An. dirus*.



Reported distribution of *An. dirus* in the World.

ANDAMAN NICOBAR ISLANDS (A&N)
1. Andaman Islands

ARUNACHAL PRADESH (ARP)
1. Tirap
2. Changlong

ASSAM (ASS)
1. Dibrugarh
2. Kamrup

KARNATAKA (KAR)
1. Shimoga
2. Hassan

KERALA (KER)
1. Wynaad

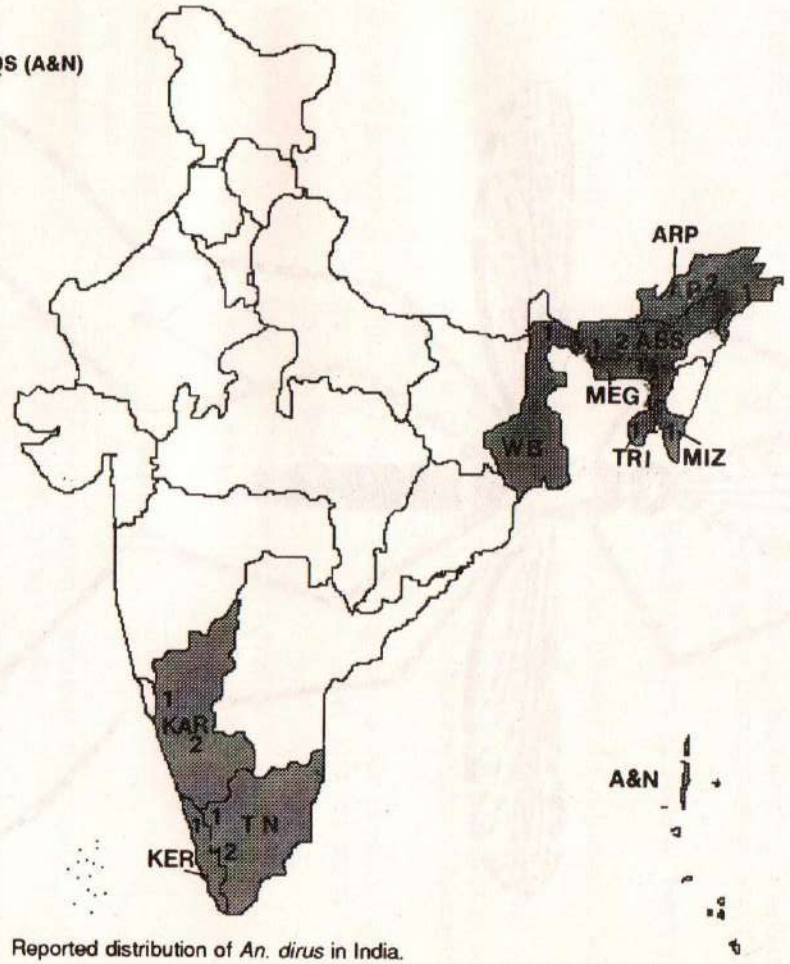
MEGHALAYA (MEG)
1. Burnihat

MIZORAM (MIZ)
1. Tiabong (Aizwal)

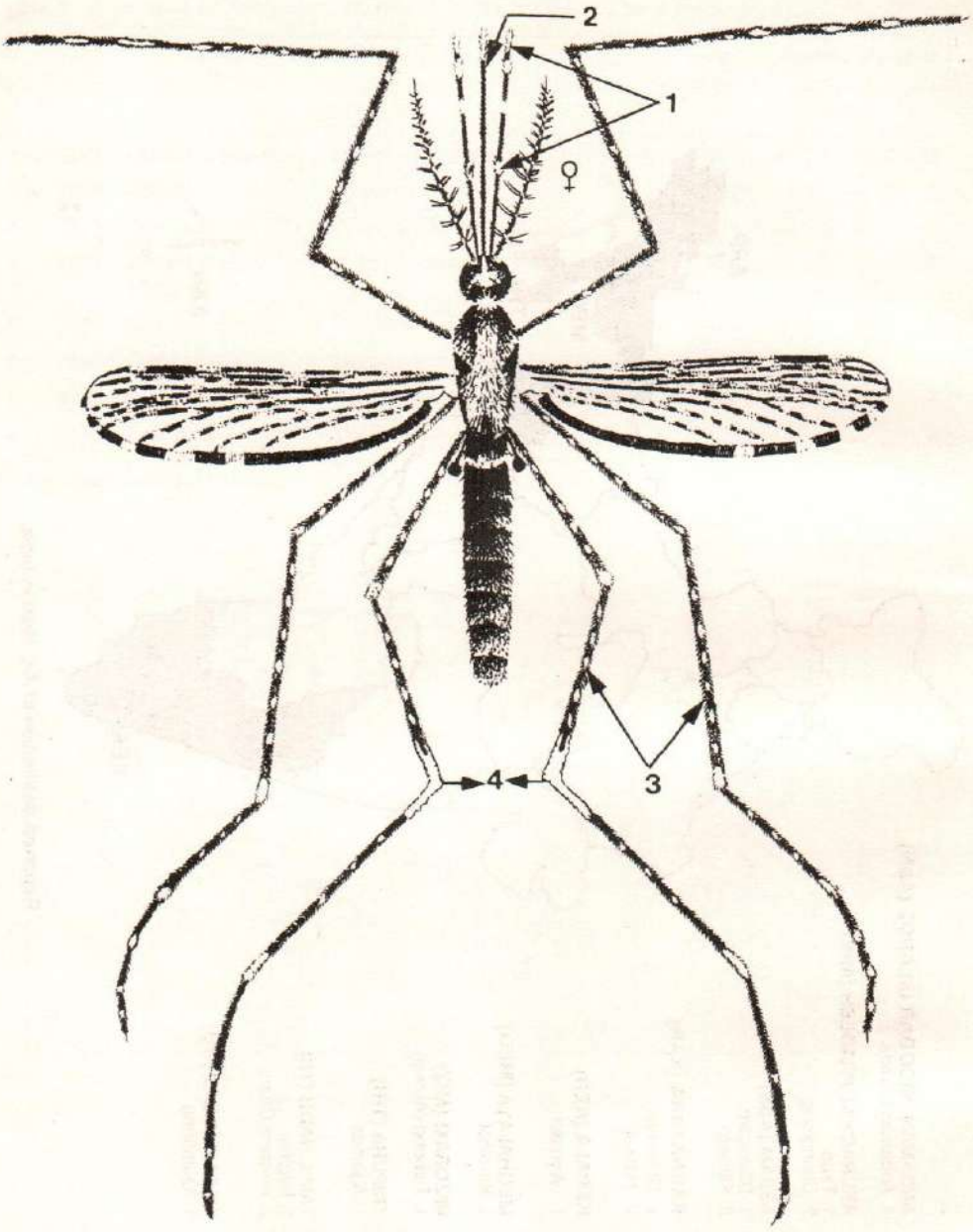
TRIPURA (TRI)
1. Agartala

TAMIL NADU (TN)
1. Nilgiris
2. Western Ghats

WEST BENGAL (WB)
1. Kalimpong



Reported distribution of *An. dirus* in India.

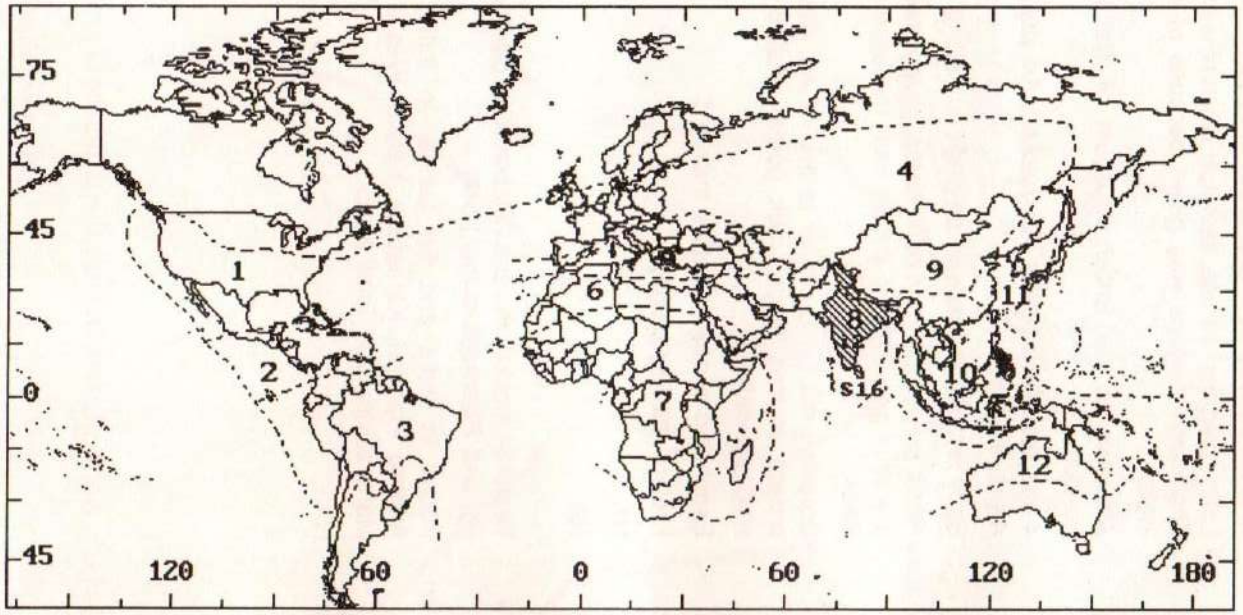


An. elegans (James) 1903, main identification characters

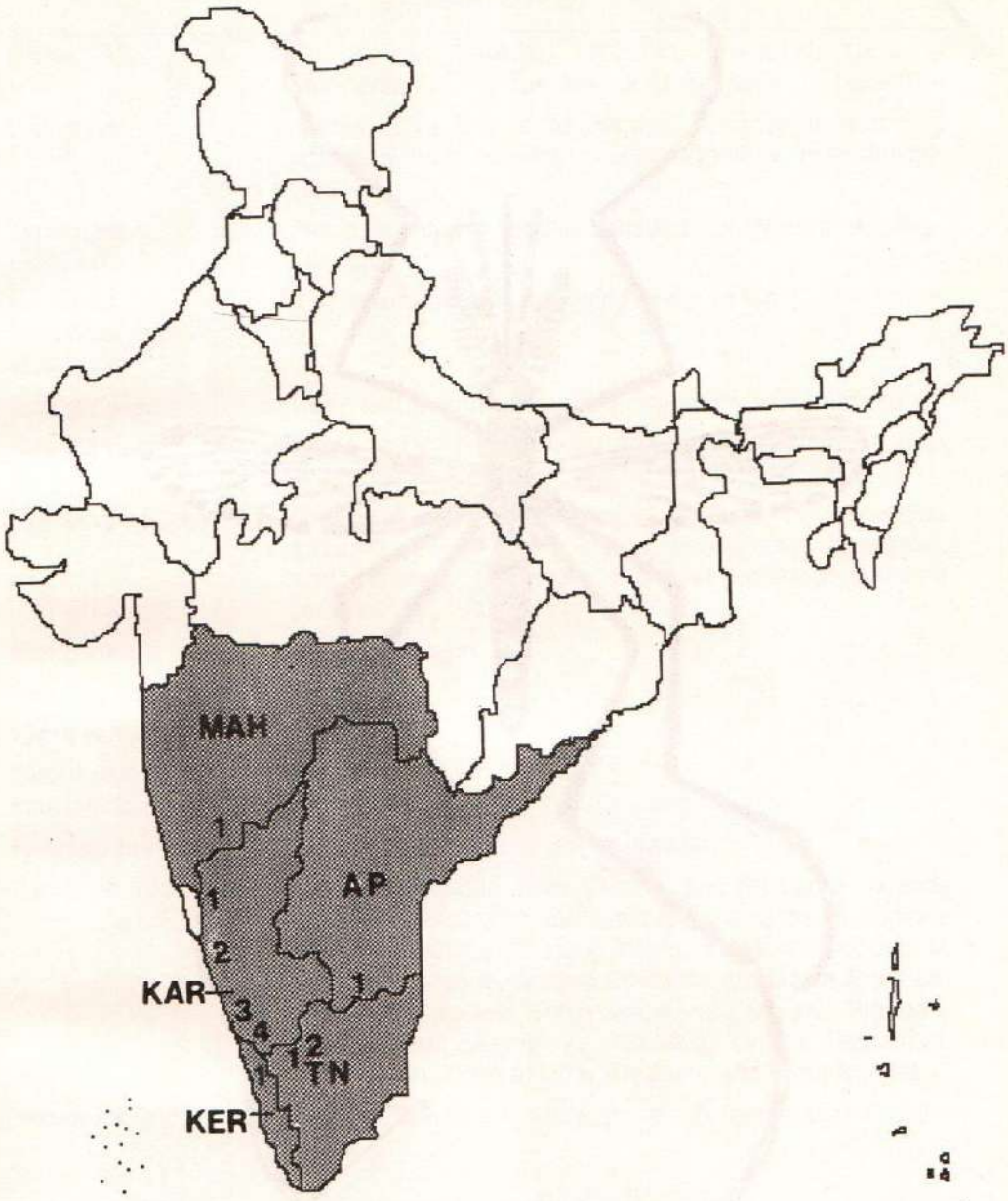
1. Four banded palpi.
2. Proboscis longer than the fore femur.
3. Legs with speckling.
4. A big white spot at the junction of femur and tibia of hind leg.

Anopheles elegans

Name	:	*An. elegans* (James), 1903. In : Theobald, *A Monograph of the Culicidae or Mosquitoes*, **3**: 51–54.
Derivative	:	Latin, *elegans*, choice, tasteful, discriminating, elegant. The name *elegans* was given because of its beautiful looks.
Type form	:	Available at the British Museum of Natural History, London.
Species complex	:	4 species (*An. elegans, An. hackeri, An. pujutensis, and An. sulawesi).*
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Rests only outdoors in dark, damp, shady places such as arecanut gardens and shrubs near the base of arecanut trees.
Breeding ecology	:	Breeding habitat is similar to that of *An. dirus*, but also breeds in tree holes, rock pools, ground pools and stagnant waters.
Biting time	:	Exophagic and bites before midnight.
Feeding preference	:	Prefers monkey blood.
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	Vector of monkey malaria (*Plasmodium* disease *cynomologi* and *Plasmodium inui*) only.
Reported distribution	:	Found in India and Sri Lanka. In India, occurs in Andhra Pradesh, Karnataka, Kerala, Western Ghats in Maharashtra, and Tamil Nadu.
Vector incrimination	:	NA



Reported distribution of *An. elegans* in the World.



ANDHRA PRADESH (AP)
1. Chittoor

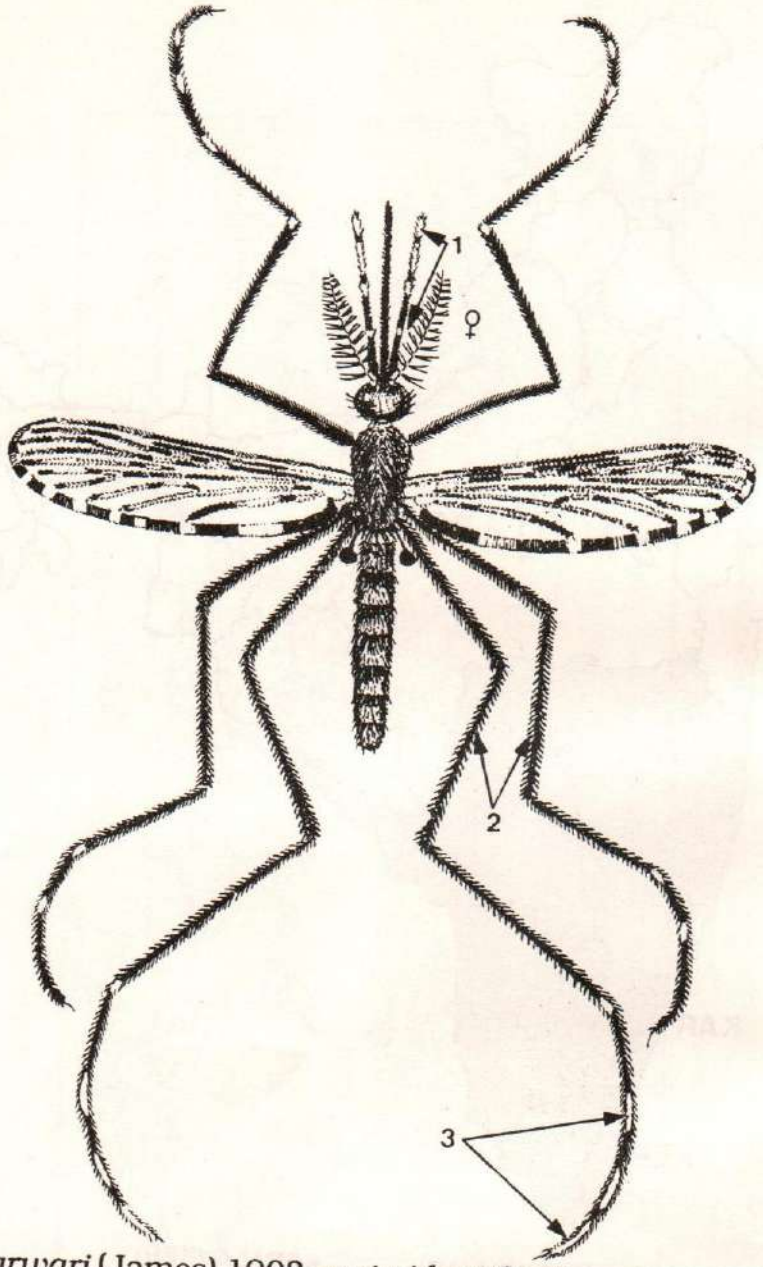
KARNATAKA (KAR)
1. North Kanara
2. Shimoga
3. Hassan
4. Mysore

KERALA (KER)
1. Wynaad

MAHARASHTRA (MAH)
1. Western Ghats

TAMIL NADU (TN)
1. Nilgiris
2. Western Ghats

Reported distribution of *An. elegans* in India.



An. karwari (James) 1903, main identification characters

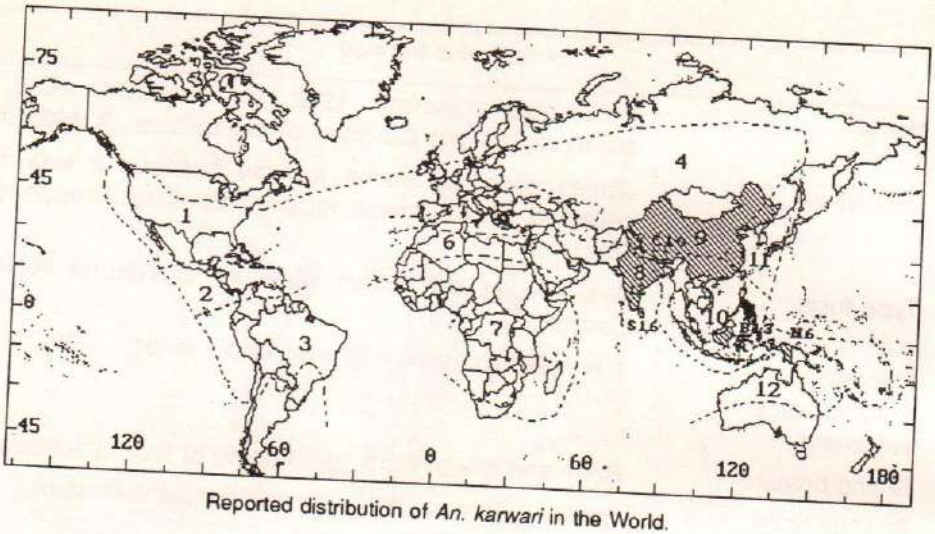
1. Four banded palpi.
2. Legs without speckling.
3. Hind leg tarsomeres banded as shown in figure.

Anopheles karwari

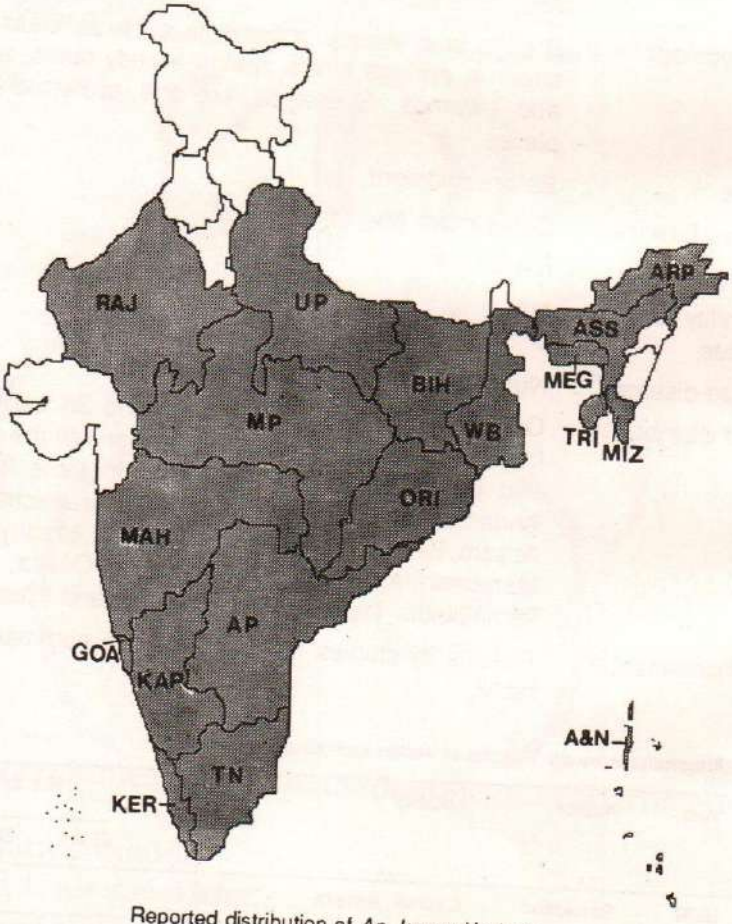
Name	:	*An. karwari* (James), 1902. In: Theobald, 1903. *A Monograph of the Culicidae or Mosquitoes* , **3**: 102–104.
Derivative	:	James gave the name *karwari* because it was first collected from Karwar locality (Bombay Presidency), Goa.
Type form	:	Available at the British Museum of Natural History, London.
Reported morphological variations	:	1 in maxillary palpi, 1 in wing and 1 in leg
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Rests in human dwellings and cattlesheds during day. Also rests outdoors.
Breeding ecology	:	Breeds in a variety of habitats such as clear- shaded streams, springs, pools, drains, weedy tanks, seepages, and swamps. Seepages are the preferred breeding places.
Biting time	:	Before midnight.
Feeding preference	:	Cattle more often than man.
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	Not regarded as a vector of malaria.
Reported distribution	:	Occurs in Borneo, New Guinea, and Sri Lanka extends from India excluding northwest regions to the Philippines and north China to Hong Kong. In India it occurs in Andaman Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Goa, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Mizoram, Orissa, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh, and West Bengal.
Vector incrimination	:	Results of studies made so far are summarized in the table.

Table : *Anopheles karwari*: Results of vector incrimination studies

Sl. No.	Year	Author	Locality	Number dissected	Number Positive		
					Gut	Gland	Total
1	1929	Strickland	Cachar, Assam	1697	1	0	1



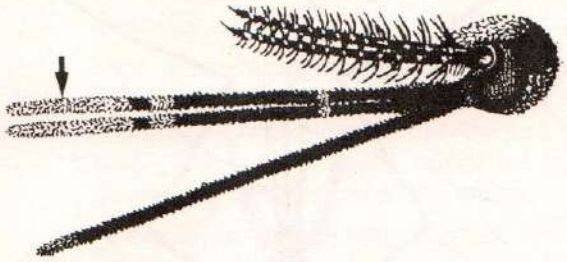
Reported distribution of *An. karwari* in the World.



Reported distribution of *An. karwari* in India.

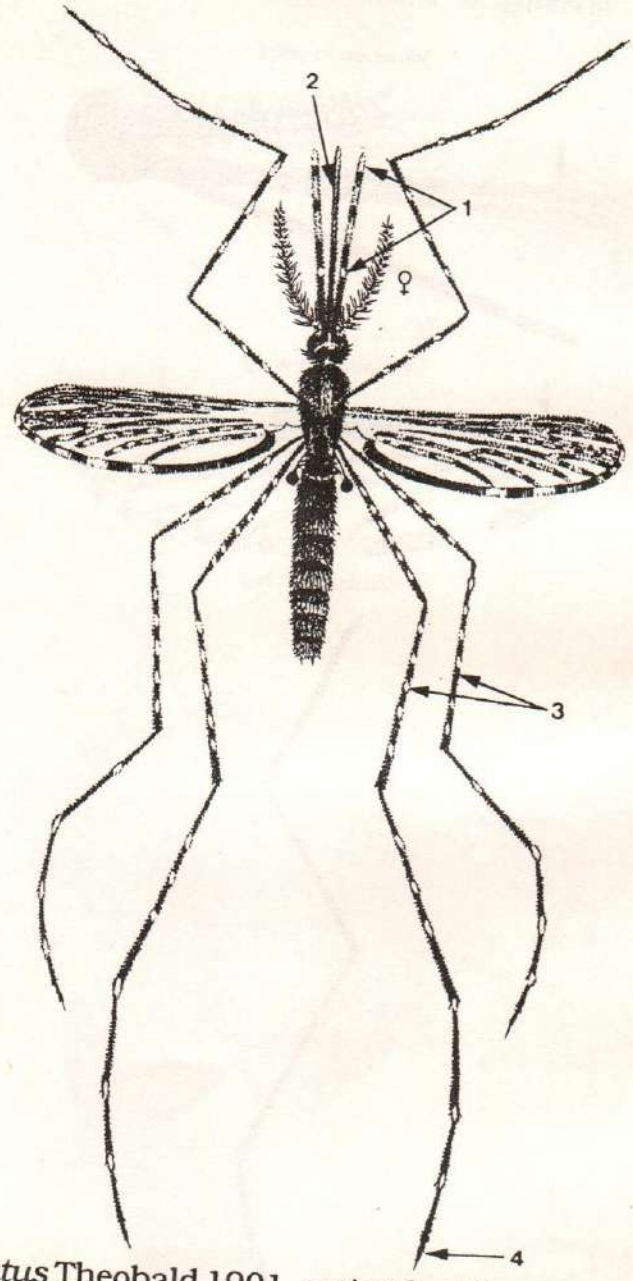
REPORTED IMPORTANT VARIATIONS OF *An. karwari*

Variation in palpi



Variation in wing

Variation in leg



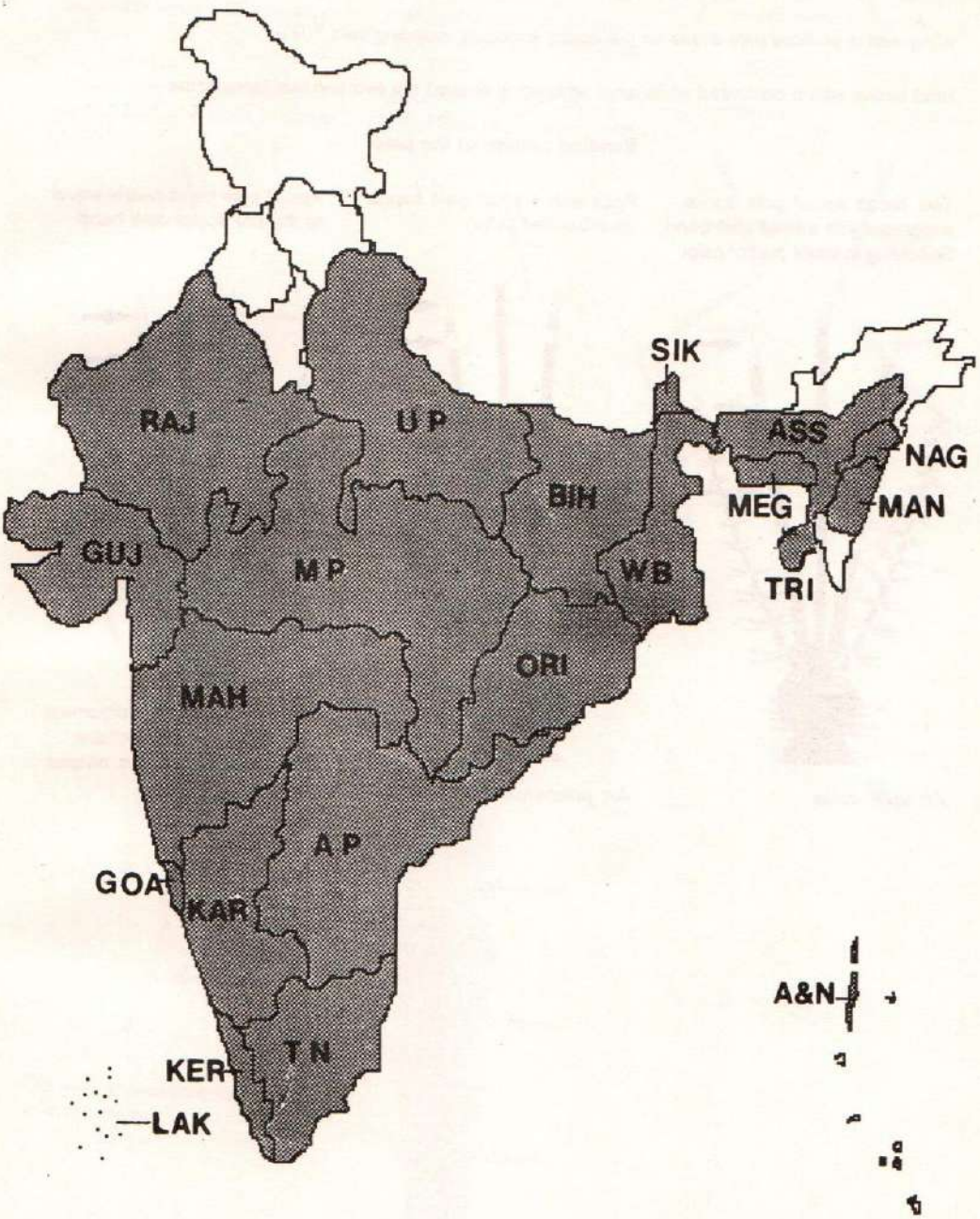
An. tessellatus Theobald 1901, main identification characters

1. Four banded palpi
2. Half of the proboscis yellow in colour
3. Legs with speckling.
4. Hind leg tarsomeres 5 completely dark but sometimes white.

Anopheles tessellatus

Name	:	*An. tessellatus* Theobald, 1901. *A Monograph of the Culicidae or Mosquitoes,* **1:** 175–176.
Derivative	:	Latin, *tessellatus,* mosaic, checkered, tessellated; (tessella, a small cube of stone used in making of pavements). Theobald likened the thoracic pattern to a mosaic, much like *An. kochi.*, but differs from it in the more tessellated appearance of the thorax.
Type form	:	Available at the British Museum of Natural History, London.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Adults rest in houses, mixed dwellings, cattlesheds and outdoors. The species rests particularly on the lower parts of the walls of houses.
Breeding ecology	:	Breeds in wells, ricefields, or channels either in sun or shade; also in dirty stagnant waters under shade.
Biting time	:	Before midnight.
Feeding preference	:	Cattle in preference to man.
Flight range	:	NA
Susceptibility to insecticides	:	Susceptible to DDT.
Relation to disease	:	A suspected vector of malaria in India (Lakshadweep Islands).
Reported distribution	:	Wide occurrence in oriental region; recorded from Bangladesh, Borneo, South China, Hong Kong, India, Indonesia, Malaysia, Maldives, Moluccas, Myanmar, Nepal, the Philippines, Sri Lanka, Sulawesi, Taiwan, and Thailand. In India, recorded from Andaman Islands, Andhra Pradesh, Assam, Bihar, Goa, Gujarat, Karnataka, Kerala, Lakshadweep, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Orissa, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, and West Bengal.
Vector incrimination	:	NA

Reported distribution of *An. tessellatus* in the World.



Reported distribution of *An. tessellatus* in India.

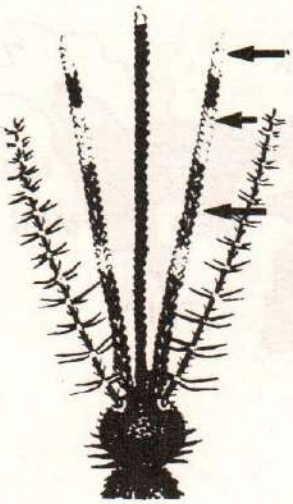
1.2 An. splendidus, An. pulcherrimus, An. jamesii, An. pseudojamesi, An. annularis, An. pallidus, An. philippinensis, An. nivipes

Wing with 4 or more pale areas on the costa, subcosta including vein 1(R1)

Hind tarsus with a continued white area embracing at least the two terminal tarsomeres

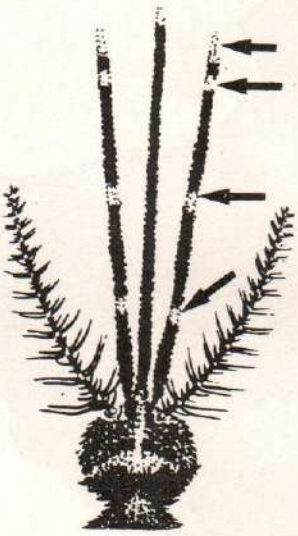
Banding pattern of the palpi

Two broad apical pale bands separated with a small dark band. Speckling in lower part of palpi



An. splendidus

Palpi with 4 small pale bands (four-banded palpi)



An. pulcherrimus

Apical pale band nearly equal to the pre-apical dark band

An. jamesii, An. pseudojamesi, An. annularis, An. pallidus, An. philippinensis, An. nivipes

An. splendidus

Other characters
Tibia and femur with speckling

Tarsomeres of hind legs 5, 4, 3, and 20% of 2 white in colour

General appearance dark and moderate size

An. pulcherrimus

Other characters
Tibia and femur without speckling but with more white areas

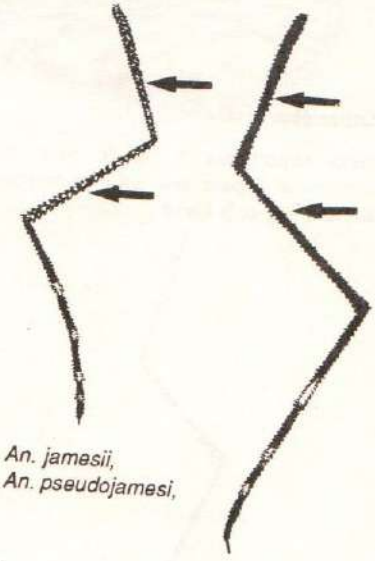
Tarsomeres of hind legs 5, 4, 3, and 50% of 2 white in colour

Abdomen densely clothed with white-scales sometimes forming tuft

An. jamesii, An. pseudojamesi, An. annularis, An. pallidus, An. philippinensis, An. nivipes

Speckling in legs

Present Absent



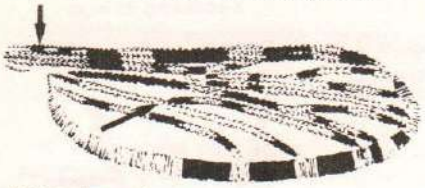
An. jamesii,
An. pseudojamesi,

An. annularis,
An. pallidus,
An. philippinensis,
An. nivipes,

An. pseudojamesi, An. jamesii

At the bifurcation of wing vein 5(Cu) and inner costa

At the bifurcation of wing vein 5(Cu) the area is pale; base of the costa mainly dark



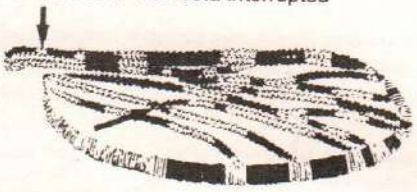
Other characters

Hind tarsomeres 5, 4, 3, and 20% of tarsomere 2 pale but apex of tarsomere 1 without any pale band

Abdomen clothed with golden hairs

Golden and medium-size mosquito
An. jamesii

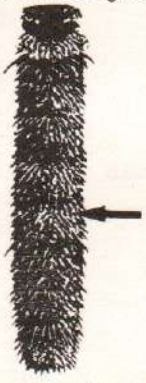
At the bifurcation of the 5(Cu) vein the area is dark; base of the costa interrupted



Other characters

Hind tarsomeres 5, 4, 3, and 20% of tarsomere 2 pale but apex of tarsomere 1 with pale band

Abdomen without golden hairs



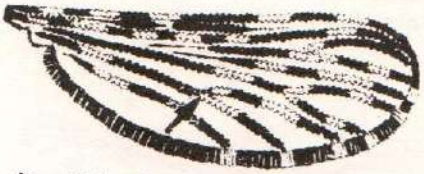
Dark and small-size mosquito
An. pseudojamesi

An. annularis, An. pallidus, An. philippinensis, An. nivipes

At the bifurcation of wing vein 5(Cu)

The area is dark

The area is pale



An. pallidus, An. philippinensis, An. nivipes

Other characters

Hind tarsomeres 5, 4, 3, and 30% of 2 pale in colour. At the apex of 1st tarsomere of hind leg a well-marked pale band is present

Medium size and dark in colour

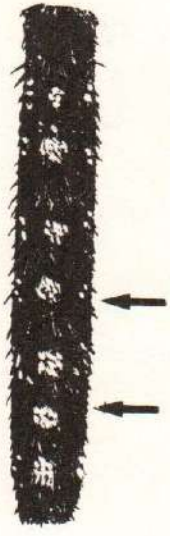
An. annularis

An. pallidus, An. philippinensis, An. nivipes

Hind tarsomeres

Hind tarsomeres 5, 4, 3, and 70% of tarsomere 2 pale. At the apex of 1st tarsomere of hind leg pale band absent

Most of the venter with scattered pale scales



Medium size and light yellow in colour

An. pallidus

Hind tarsomeres 5, 4, 3, and 50% of tarsomere 2 pale. At the apex of 1st tarsomere of hind leg a small pale band present

Pale scales restricted to last few apical segments of the venter

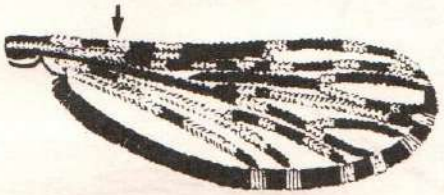
Medium size and dark in colour

(*An. philippinensis, An. nivipes*)

An. philippinensis, An. nivipes

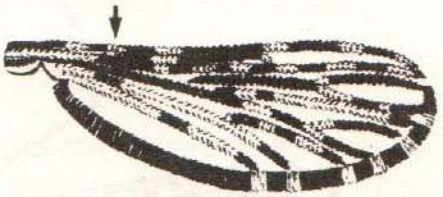
Pre-sector dark mark of vein 1(R1)

Pre-sector dark mark of vein 1(R1) extended basally beyond the end of the corresponding marking on the costa, but not reaching up to the distal end of humeral dark mark

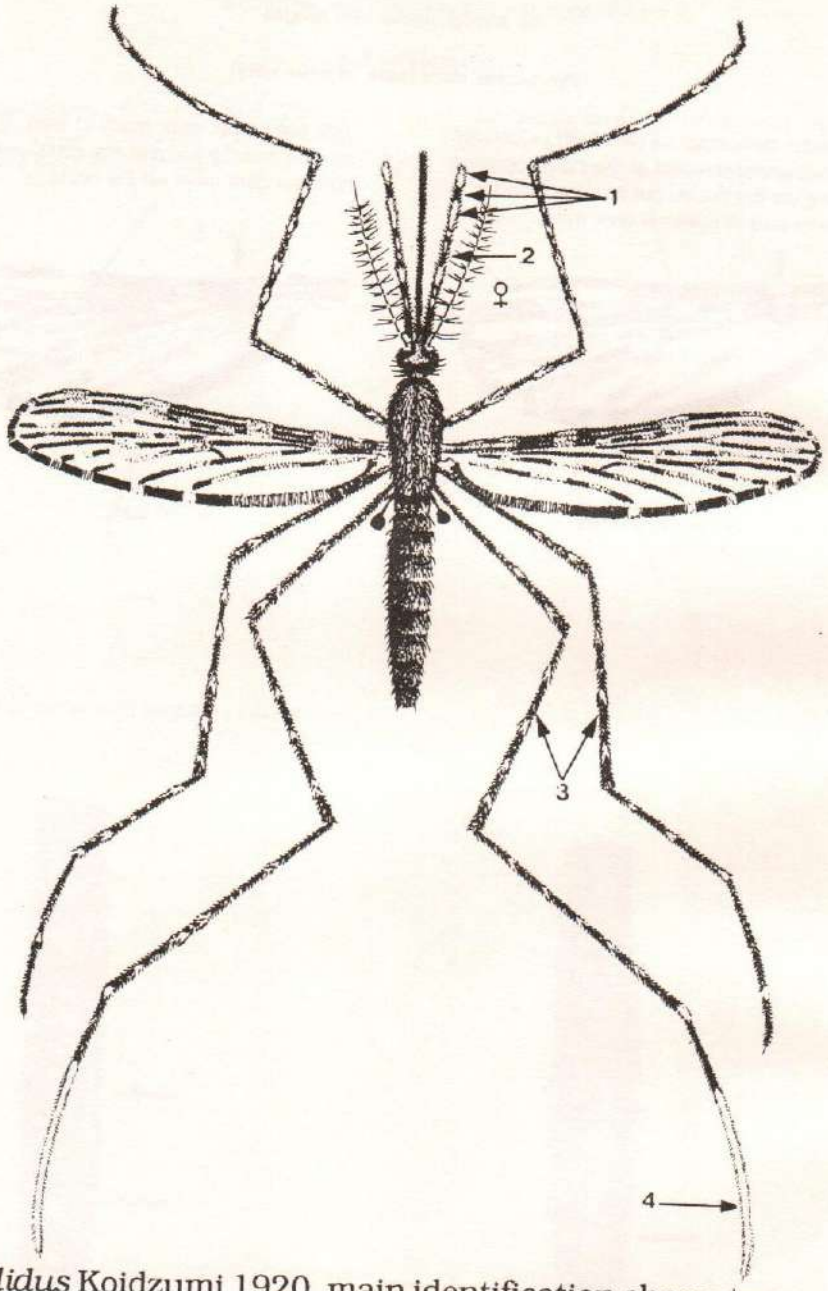


An. philippinensis

The pre-sector dark mark of vein 1(R1) extending basally beyond the distal end of the humeral dark mark on the costa



An. nivipes



An. splendidus Koidzumi 1920, main identification characters

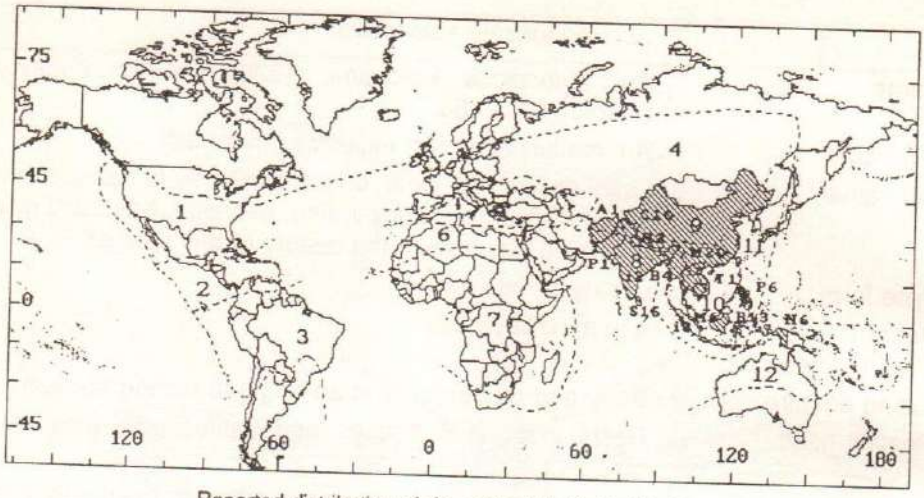
1. Apical and subapical pale bands equal and separated by a dark band.
2. Palpi with speckling.
3. Legs with speckling.
4. Hind tarsomeres 5, 4 and 3 atleast completely white.

Anopheles splendidus

Name	:	*An. splendidus* Koidzumi, 1920. *Daiwan Kenkyujo Hokoku,* **8**: 1–158.
Old name	:	*An. maculipalpis* var. *indiensis,* Theobald.
Derivative	:	Latin, *splendidus,* clear, bright, spotlessly or transparently brilliant, gleaming, showy, fine, beautiful. Koidzumi gave the name because of the beauty of this species.
Type form	:	Location not known.
Reported morphological variations	:	4 in maxillary palpi
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Rests indoors in houses and cattlesheds; also rests outdoors in forest areas.
Breeding ecology	:	Breeds in pools with algal vegetation in riverbeds, clear pools in riverbeds, jungle streams, ponds with aquatic vegetation, tanks with weeds, marshy lake margins, and tree holes.
Biting time	:	Before midnight.
Feeding preference	:	Primarily a cattle feeder but may occasionally bite man.
Flight range	:	1 to 1.5 km.
Susceptibility to insecticides	:	Resistant to dieldrin.
Relation to disease	:	No role in malaria transmission.
Reported distribution	:	Occurs in Afghanistan, Bangladesh, China, India, Indochina, Myanmar, Nepal, Pakistan, Taiwan, and Thailand. In India, found in Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Jammu & Kashmir, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh, and West Bengal.
Vector incrimination	:	Results of studies made so far are summarized in the table.

Table : *Anopheles splendidus*: Results of vector incrimination studies

Sl. No.	Year	Author	Locality	Number dissected	Number Positive		
					Gut	Gland	Total
1.	1931	Macdonald & Majid	Karnal, Haryana	26	1	0	1
2.	1935	Senevet	India	289	1	0	1
3.	1944	Covell	India	26	–	–	1
4.	1948	Subramanian & Dixit	Khandwa, Madhya Pradesh	9	0	9	9

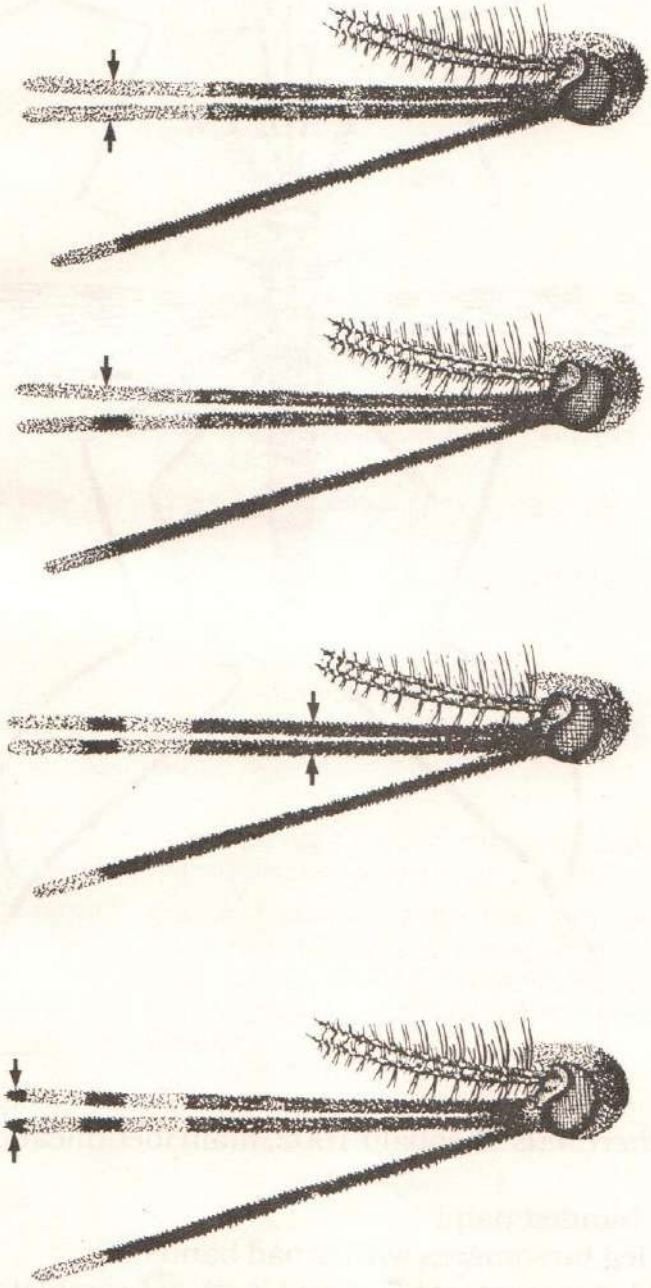


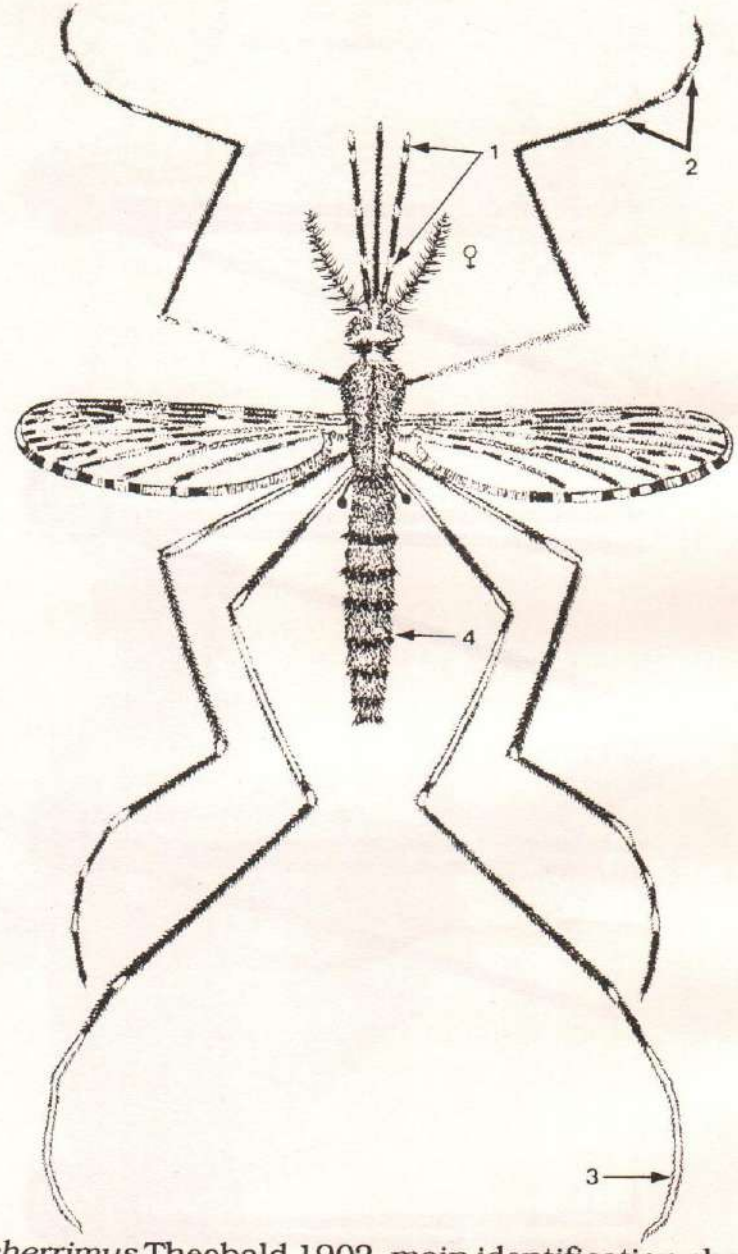
Reported distribution of *An. splendidus* in the World.

Reported distribution of *An. splendidus* in India.

REPORTED IMPORTANT VARIATIONS OF *An. splendidus*

Variations in palpi



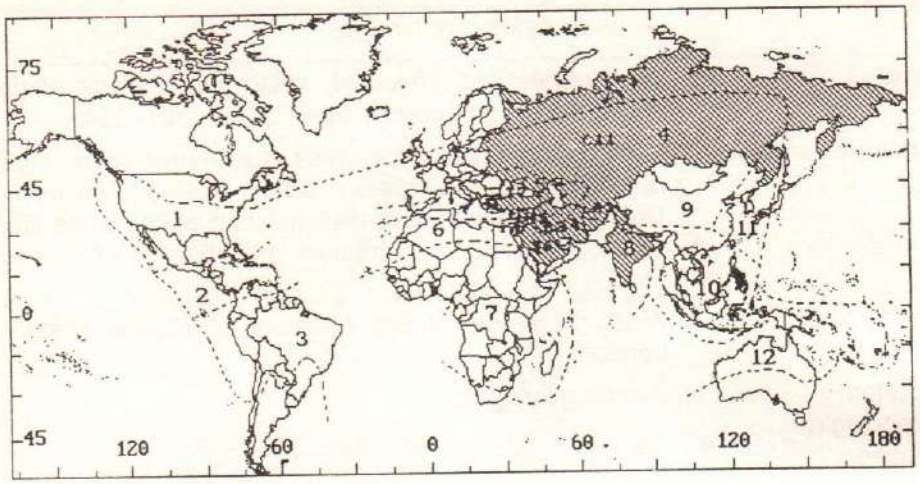


An. pulcherrimus Theobald 1902, main identification characters

1. Four banded palpi
2. Fore leg tarsomeres with broad bands
3. Hind leg tarsomeres 5, 4 and 3 atleast completely white
4. Lateral abdomen with tufts of golden scales

Anopheles pulcherrimus

Name	:	*An. pulcherrimus* Theobald, 1902. *Proceedings of the Royal Society of London, Series B*, **69**: 367–394.
Derivative	:	Latin, *pulcher,* beautiful; *-imus*, superlative suffix, most beautiful. A beautiful species, closely related to *An. kochi*, Doenitz, but quite easily distinguished by the white hind tarsomers, wing ornamentation, and absence of thoracic ocelli.
Type form	:	Available at the British Museum of Natural History, London.
Reported morphological variations	:	2 in maxillary palpi
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Prefers human dwellings to cattlesheds, also rests outdoors. Adults prefer to rest in partly shaded places in houses.
Breeding ecology	:	Ground pools, borrowpits with good growth of vegetation, ricefields, and shallow lakes.
Biting time	:	Peak activity before midnight from 18.00 to 21.00 hrs.
Feeding preference	:	Cattle to man.
Flight range	:	A hardy species and strong flier, e.g., the swarm of this species was observed over a ship about 25 km from mainland in Shat-al-Arab in the Persian Gulf.
Susceptibility to insecticides	:	NA
Relation to disease	:	In India, is not a vector but transmits malaria in northern Afghanistan and southern parts of USSR.
Reported distribution	:	Occurs in Bahrain, India, Iran, Iraq, Israel, Lebanon, Saudi Arabia, Syria, and Turkey. In India, recorded from Delhi, Gujarat, Haryana, Karnataka, Maharashtra, Orissa, Punjab, Rajasthan, Sikkim, Uttar Pradesh, and West Bengal.
Vector incrimination	:	NA



Reported distribution of *An. pulcharrimus* in the World.

DELHI-UT (DEL)
1. Delhi

GUJARAT (GUJ)
1. Kutch
2. Kheda
3. Panchmahals
4. Ahmedabad

HARYANA (HAR)
1. Karnal

KARNATAKA (KAR)
1. Bijapur

MAHARASHTRA (MAH)
1. Bombay

ORISSA (ORI)
1. Baleshwar
2. Cuttack
3. Puri
4. Ganjam

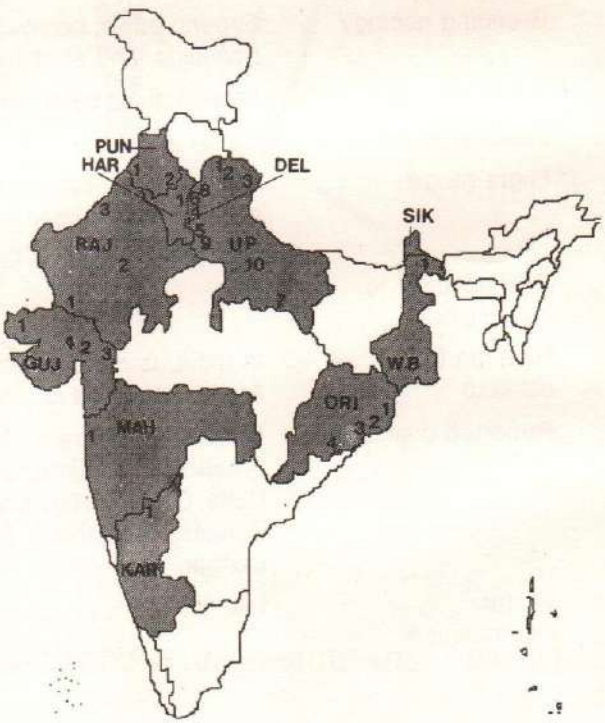
PUNJAB (PUN)
1. Ferozepur
2. Patlala

RAJASTHAN (RAJ)
1. Sirohi
2. Ajmer
3. Bikaner

SIKKIM (SIK)
1. North Sikkim
2. West Sikkim

UTTAR PRADESH (UP)
1. Uttarkashi
2. Tehri Garhwal
3. Pithoragarh
4. Meerut
5. Ghaziabad
6. Saharanpur
7. Allahabad
8. Dehra Dun
9. Bulandshahar
10. Kanpur

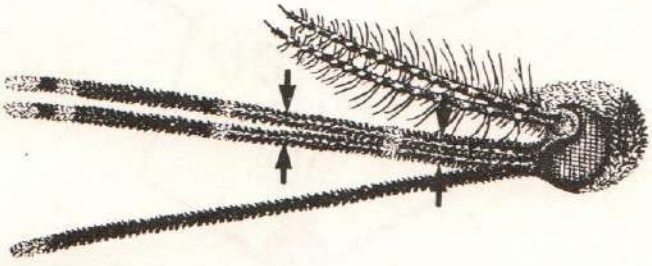
WEST BENGAL (WB)
1. Jalpaiguri

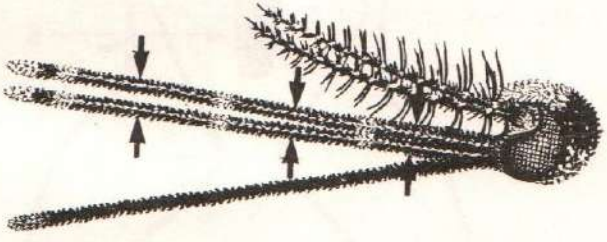


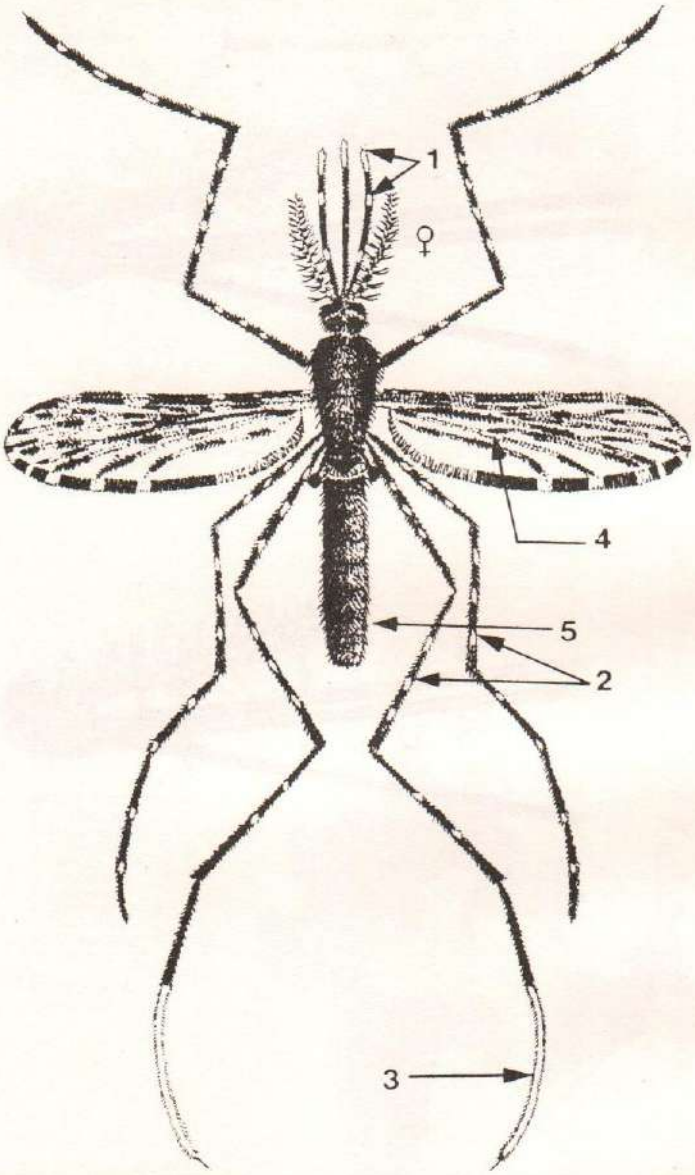
Reported distribution of *An. pulcherrimus* in India.

REPORTED IMPORTANT VARIATIONS OF *An. pulcherrimus*

Variations in palpi







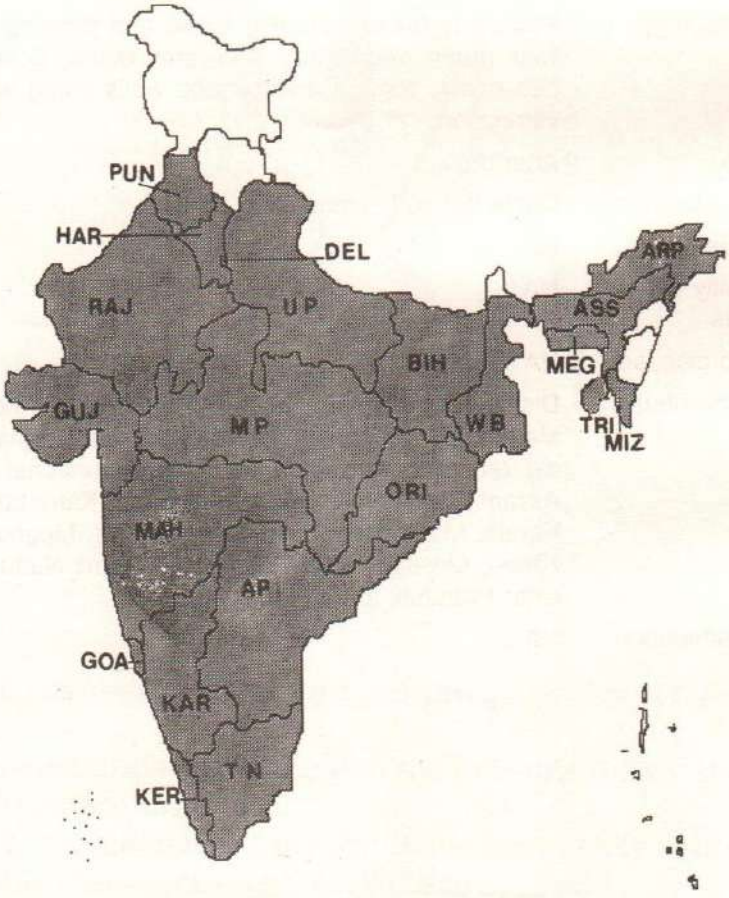
An. jamesii Theobald 1901, main identification characters

1. Apical pale band nearly equal to the pre-apical dark band.
2. Legs with speckling.
3. Hind leg tarsomeres 5, 4 and 3 atleast completely white.
4. At the bifurcation of vein 5 (CU) the area is pale.
5. Abdomen with golden hairs.

Anopheles jamesii

Name	:	*An. jamesii* Theobald, 1901. *A Monograph of the Culicidae or Mosquitoes*, **1**: 134–135.
Derivative	:	Theobald named this species after Captain Sydney Price James, a wellknown malariologist.
Type form	:	Available at the British Museum of Natural History, London.
Reported morphological variations	:	2 in maxillary palpi
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Adults rest inside houses, cattlesheds, and mixed dwellings during the day. The species also rests outdoors in forest areas.
Breeding ecology	:	Prefers to breed in tanks, fallow and growing ricefields with green vegetation, rainwater pools, ponds, river-bed pools, springs and surface wells along with green vegetation.
Biting time	:	After dusk.
Feeding preference	:	Cattle but sometimes man.
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	NA
Reported distribution	:	Distributed in Bangladesh, China, India, Indo-China, Malaya, Myanmar, Nepal, Sri Lanka, and Thailand. In India, recorded from Andhra Pradesh, Arunachal Pradesh, Assam, Delhi, Goa, Gujarat, Haryana, Karnataka, Bihar, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Mizoram, Orissa, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh, and West Bengal.
Vector incrimination	:	NA

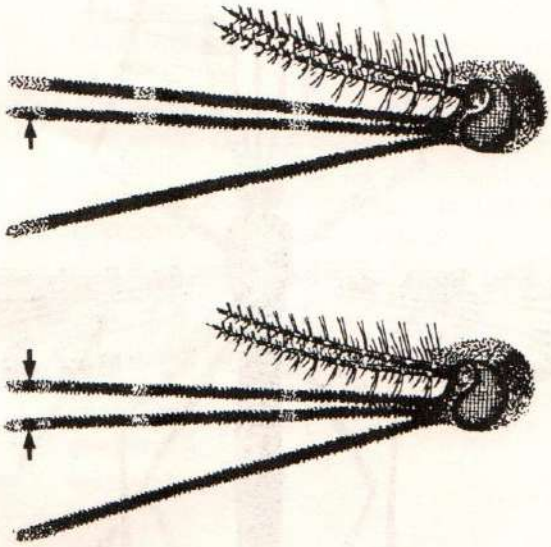
Reported distribution of *An. jamesii* in the World.



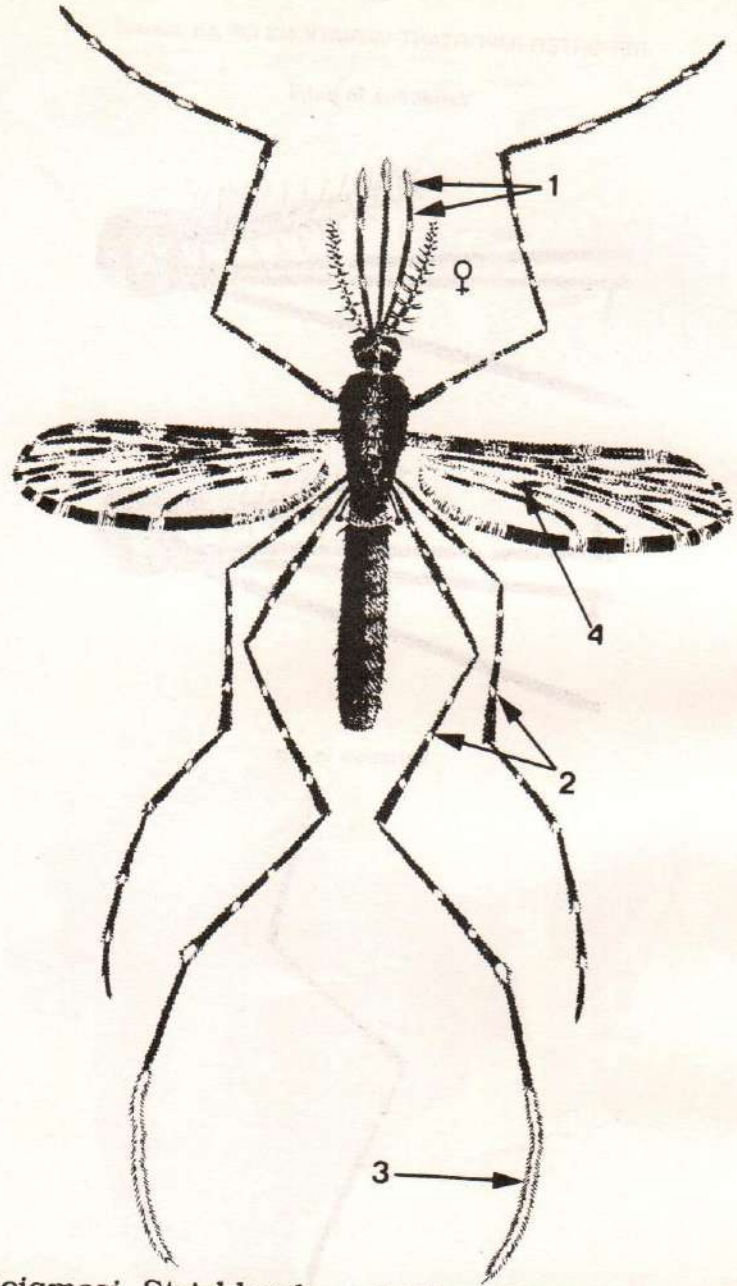
Reported distribution of *An. jamesii* in India.

REPORTED IMPORTANT VARIATIONS OF *An. jamesii*

Variations in palpi



Variation in leg



An. pseudojamesi Strickland and Chowdhury 1927, main identification charecters

1. Apical pale band nearly equal to the pre-apical dark band.
2. Legs with speckling.
3. Hind leg tarsomeres 5, 4 and 3 atleast completely white.
4. At the bifurcation of wing vein 5 (CU) the area is dark.

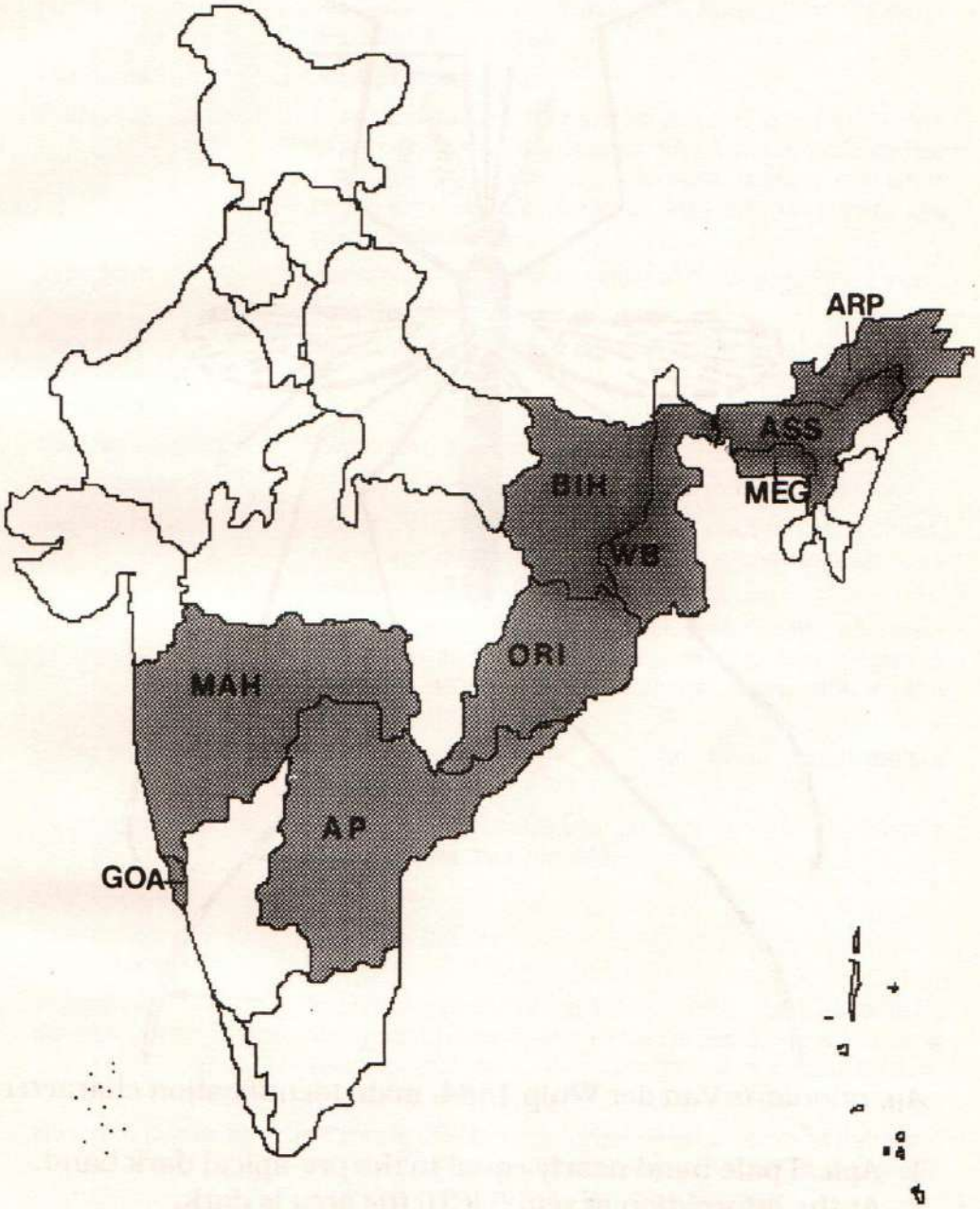
Anopheles pseudojamesi

Name	:	*An. pseudojamesi* Strickland and Chowdhury, 1927. *The Indian Medical Gazette.* **62**: 240–243.
Old Name	:	*An. ramsayi*
Derivative	:	Larvae which were identified as *pulcherrimus* gave rise to *jamesi*-like adults, and when a sufficient number of specimens had been collected it became clear that this species was neither *jamesi* nor *pulcherrimus* and therefore it was named *pseudojamesi.* Covell (1927) described it as *An. ramsayi.* In 1985 Nurul Huda and Harrison renamed it *An. pseudojamesi.*
Type form	:	Available at the British Museum of Natural History, London.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Adults rest in houses and cattlesheds.
Breeding ecology	:	Breeds in rainwater pools, tanks and swamps with heavy growth of vegetation.
Biting time	:	Before midnight.
Feeding preference	:	Man and cattle.
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	Some specimens were found positive with gut and gland infection in Assam; hence the species is known as a poor or insignificant vector of malaria in India.
Reported distribution	:	Distributed in Bangladesh, Myanmar, Nepal, and Sri Lanka; in India restricted to Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Goa, Maharashtra, Meghalaya, Orissa, and West Bengal.
Vector incrimination	:	Results of studies made so far are summarized in the table.

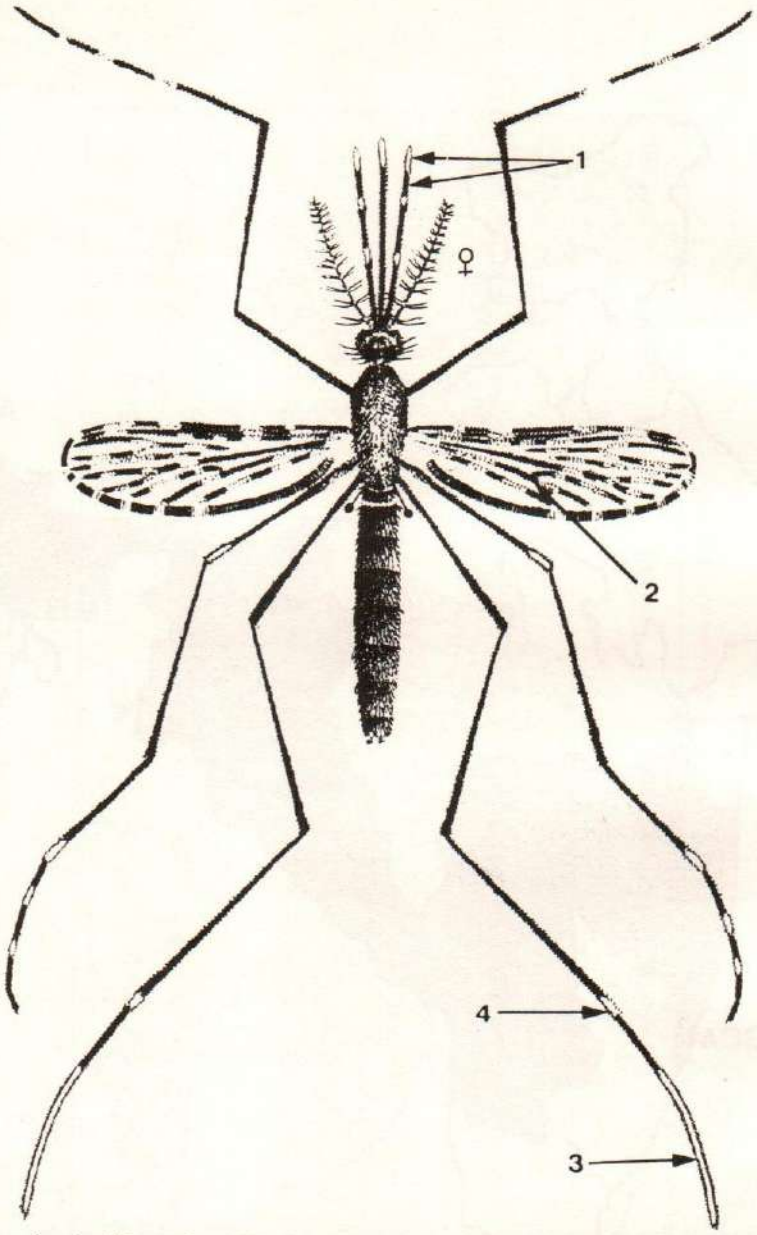
Table : *Anopheles pseudojamesi*: Results of vector incrimination studies

Sl. No.	Year	Author	Locality	Number dissected	Number Positive		
					Gut	Gland	Total
1.	1929	Strickland	Cachar, Assam	256	0	1	1
2.	1930	Ramsay	Assam	287	1	0	1
3.	1936	Ramsay & Macdonald	Assam	2217	4	0	4
4.	1942	Panigrahi	West Bengal	1658	1	0	1
5.	1943	Senior White *et al.*	Orissa coastal plains	556	1	0	1
6.	1944	Covell	Assam	2217	0	1	1
7.	1940	Iyengar	West Bengal	557	1	0	1
8.	1944	Iyengar	Deltic West Bengal	742	1	0	1

Reported distribution of *An. pseudojamesi* in the World.



Reported distribution of *An. pseudojamesi* in India.



An. annularis Van der Wulp 1884, main identification characters

1. Apical pale band nearly equal to the pre-apical dark band.
2. At the bifurcation of vein 5 (CU) the area is dark.
3. Hind leg tarsomeres 5, 4 and 3 atleast completely white.
4. A pale band at the junction of hind tarsomeres 1 and 2.

Anopheles annularis

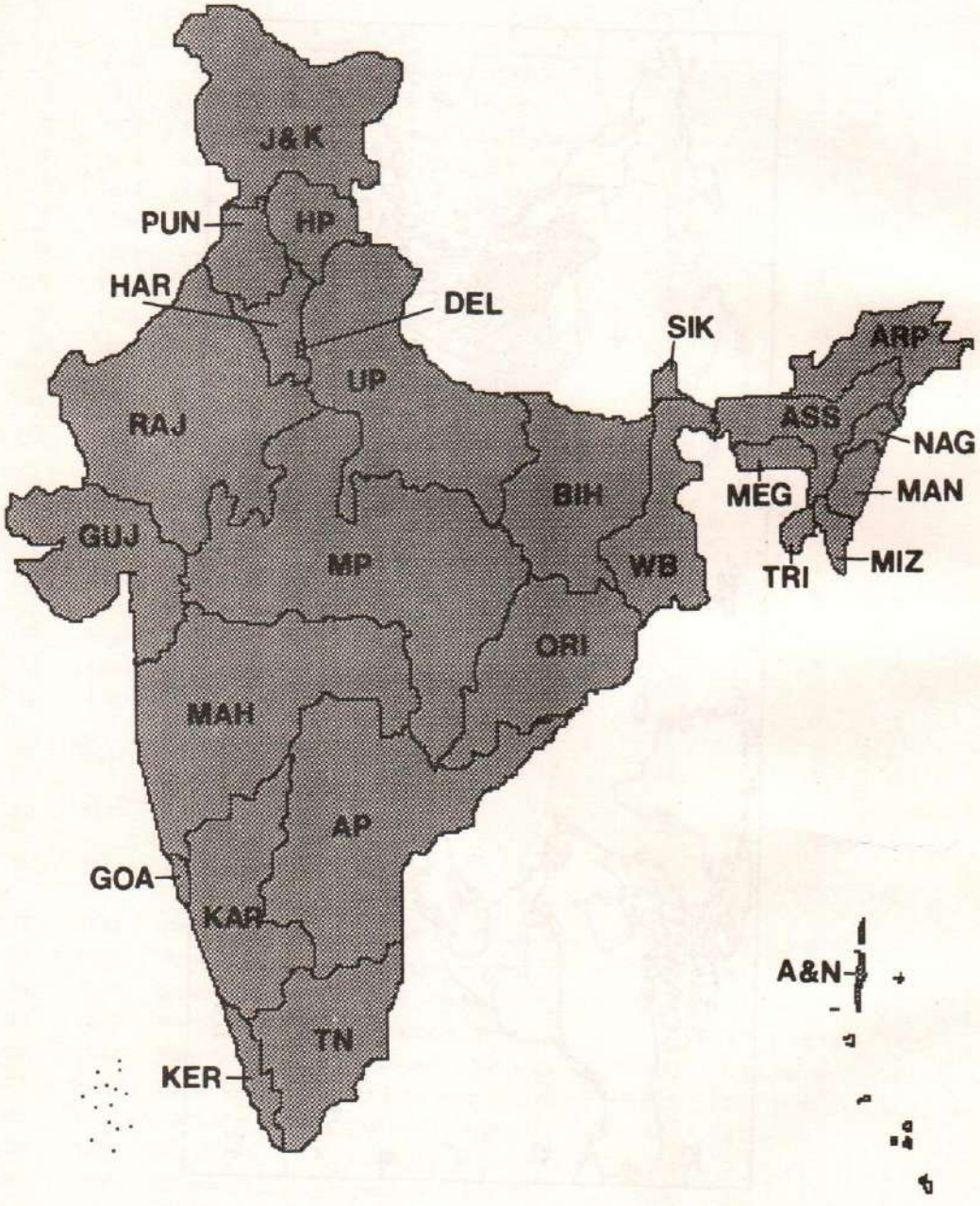
Name	:	*An. annularis* Van der Wulp, 1884. *Notes from the Leyden Museum.* **6**: 248–256.
Old name	:	*An. fuliginosus* Giles
Derivative	:	Latin, *annularis,* of a ring; from *annulus*, a late Latin form of *annulus,* diminutive of *anus*, ring. Van der Wulp named it *An. annularis* because it is a ringed species, with white palpal rings as well as white rings on the anterior and posterior tarsi.
Type form	:	Available at the State Museum of Natural History, Liyden, Netherlands.
Reported morphological variations	:	10 in maxillary palpi, 6 in leg and 6 in wing
Species complex	:	Two sibling species.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Adults rest in good numbers in houses, cattlesheds, and mixed dwellings during day. The species also rests outdoors in small numbers.
Breeding Ecology	:	Predominantly breeds in still water with abundant vegetation in tanks, ponds, borrowpits. Also breeds in ricefields, wells, margins of rivers, lakes, stream with green vegetation.
Biting time	:	Bites throughout night, but peak biting occurs before midnight.
Feeding preference	:	Predominantly a cattle biter (zoophilic) but in the absence of cattle bites man readily.
Flight range	:	Up to 1 km.
Susceptibility to insecticides	:	Resistant to DDT
Relation to disease	:	Secondary vector of malaria in China, India, Indonesia, Malaysia, Myanmar and Nepal. In India, known to be a vector of malaria in several localities of coastal Orissa, Bihar, and West Bengal.
Reported distribution	:	Occurs in oriental regions from Afghanistan and Pakistan, India, Indochina, the Philippines, and Sri Lanka. In India, recorded from all zones including Kashmir.
Vector incrimination	:	Results of studies made so far are summarized in the table.

Table : *Anopheles annularis*: Results of vector incrimination studies

Sl. No.	Year	Author	Locality	Number dissected	Number Positive		
					Gut	Gland	Total
1.	1905	Adie	Ferozepur, Punjab	142	0	1	1
2.	1911	Christophers	Amritsar, Punjab	100	0	–	–
3.	1913	Graham	Meerut, Uttar Pradesh	251	3	0	3
4.	1914	Bentley	West Bengal	685	0	3	3
5.	1914	Fry	West Bengal	1245	0	1	1
6.	1924	Watts	Singbhum, Orissa	NM	–	–	–
7.	1927	Iyengar	West Bengal	156	0	2	2
8.	1927	Covell	West Bengal	2511	3	4	7
9.	1928	Iyengar	Hooghly, West Bengal	125	0	1	1
10.	1929	Sur & Sur	Krishna Nagar, West Bengal	3944	0	6	6
11.	1929	Sur & Sur	Birnagar, West Bengal	787	0	1	1
12.	1929	King & Krishnan	Udayagiri, Madras Tamil Nadu	8	1	0	1
13.	1931	Macdonald & Majid	Karnal, Haryana	NM	0.5%	–	–
14.	1935	Timbers	Birbhum, West Bengal	49698	0	8	8
15.	1939	Senior White & Adhikari	Chilka lake area, Orissa	1048	3	0	3
16.	1940	Iyengar	West Bengal	5155	1	1	2
17.	1940	Iyengar	West Bengal	NM	–	–	0.4%
18.	1940	Senior White & Adhikari	West Bengal	1627	2	0	2
19.	1941	Viswanathan *et al.*	Assam	7481	4	7	11
20.	1941	Anderson & Viswanathan	Assam	16760	3	6	9
21.	1941	Rao	Bengal Prov. West Bengal	884	5	2	7
22.	1942	Covell & Singh	Chilka lake, Orissa	20844	1	0	1
23.	1942	Panigrahi	Puri, Orissa	9096	5	7	12
24.	1943	Senior White *et al.*	Orissa Plain	9183	14	7	21
25.	1943	Senior White	Hazaribagh, Bihar	1030	1	0	1
26.	1944	Rao	Dhanbad, Bihar	NM	0.5%	0.1%	–
27.	1946c	Senior White	E. Cen. India	215	0	1	1
28.	1982	Dash *et al.*	Keonjhar, Orissa	174	0	1	1
29.	1985	Ghosh *et al.*	West Bengal	5428	0	1	1
30.	1989	Gunasekaran *et al.*	Koraput, Orissa	3608	2	1	3

NM - Not Mentioned

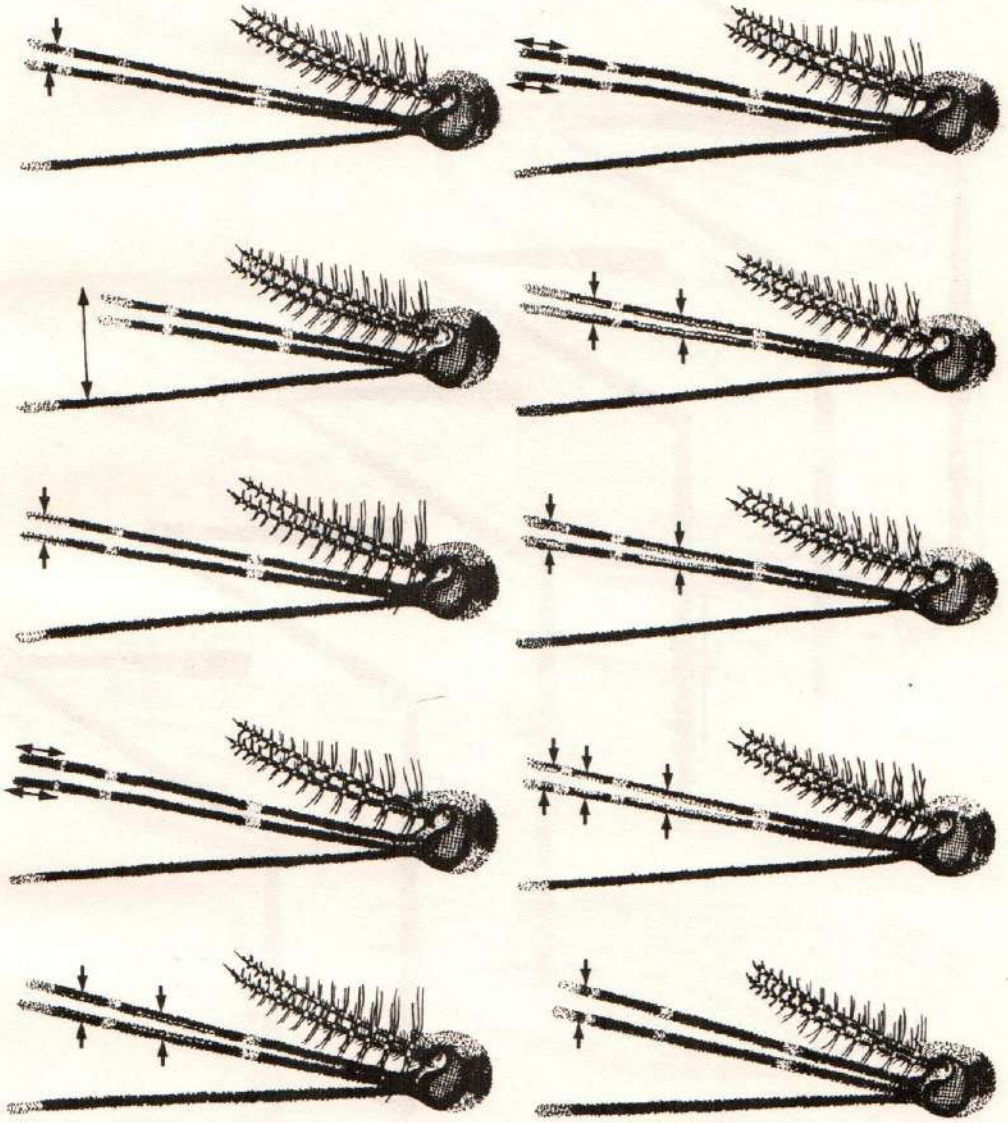
Reported distribution of *An. annularis* in the World.



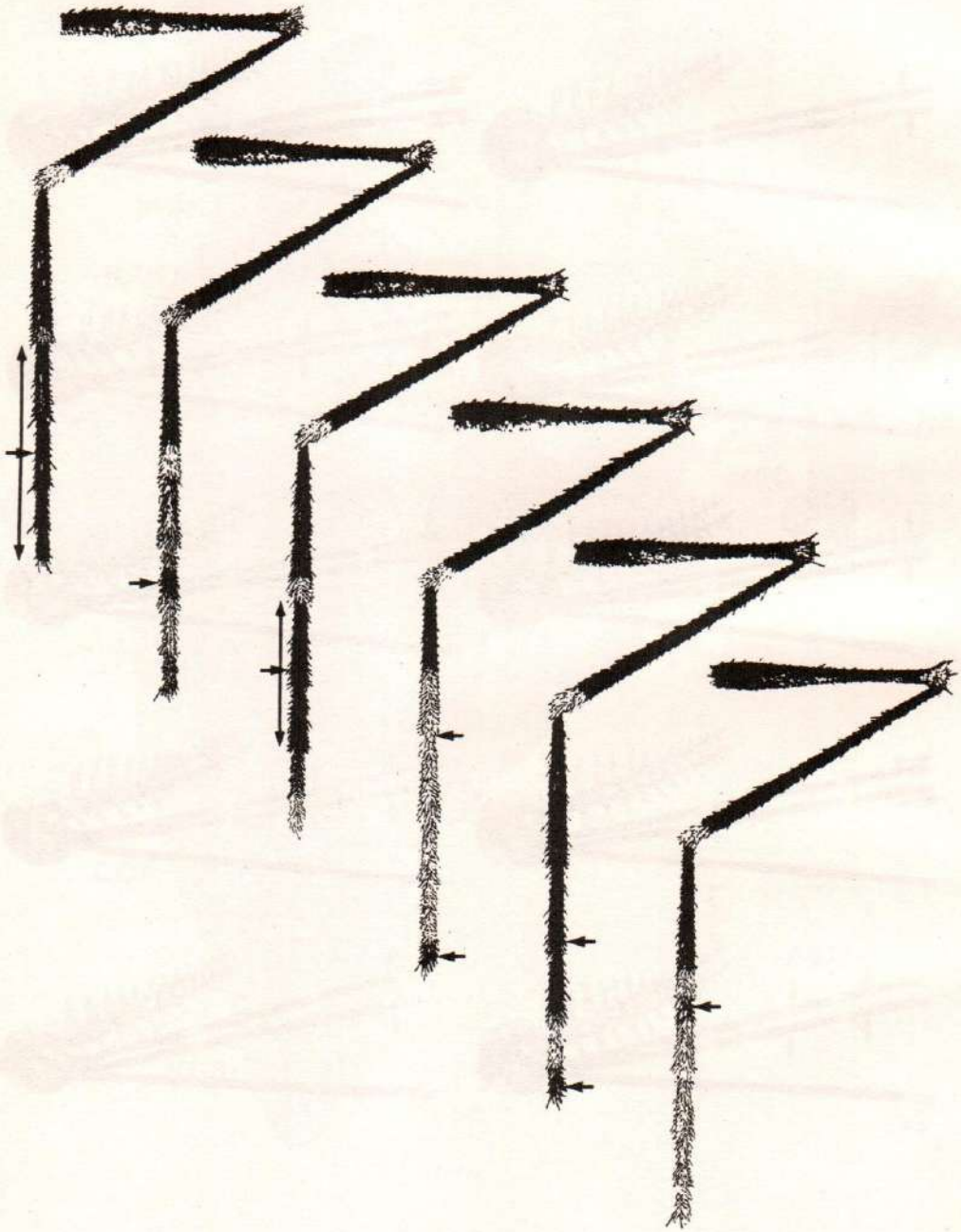
Reported distribution of *An. annularis* in India.

REPORTED IMPORTANT VARIATIONS OF *An. annularis*

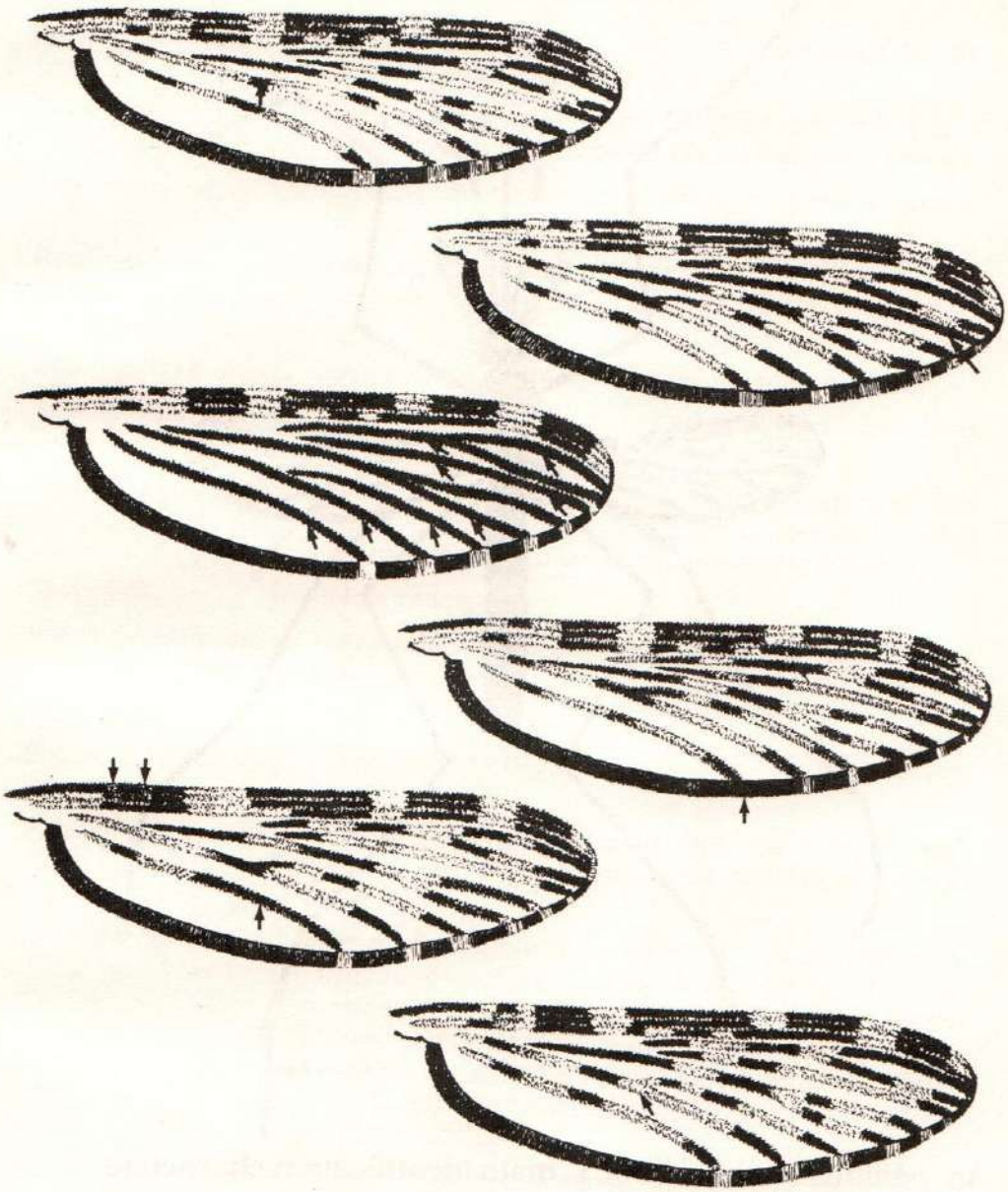
Variations in palpi

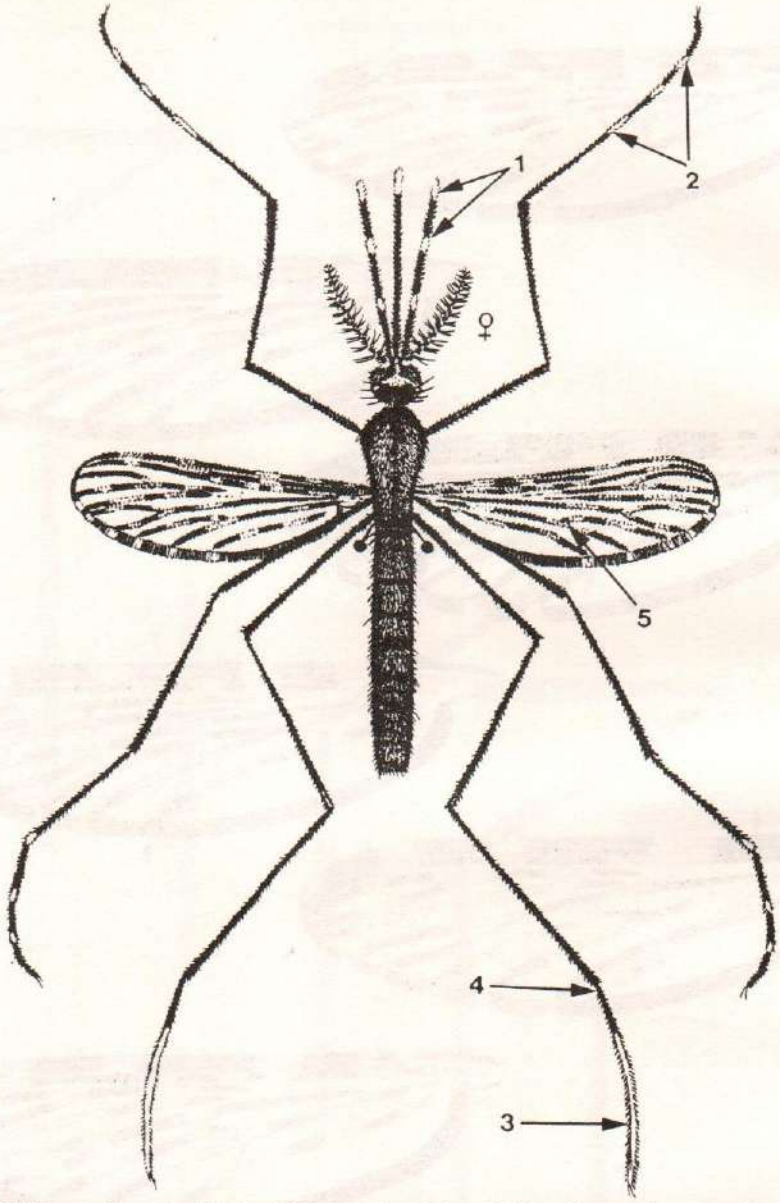


Variations in leg



Variations in wing





An. pallidus Theobald 1901, main identification characters

1. Apical pale band nearly equal to the pre-apical dark band.
2. Fore leg tarsomeres with broad bands.
3. Hind leg tarsomeres 5, 4 and 3 atleast completely white
4. Pale band at the junction of hind tarsomeres 1 and 2 absent
5. At the bifurcation of vein 5 (CU) the area is pale

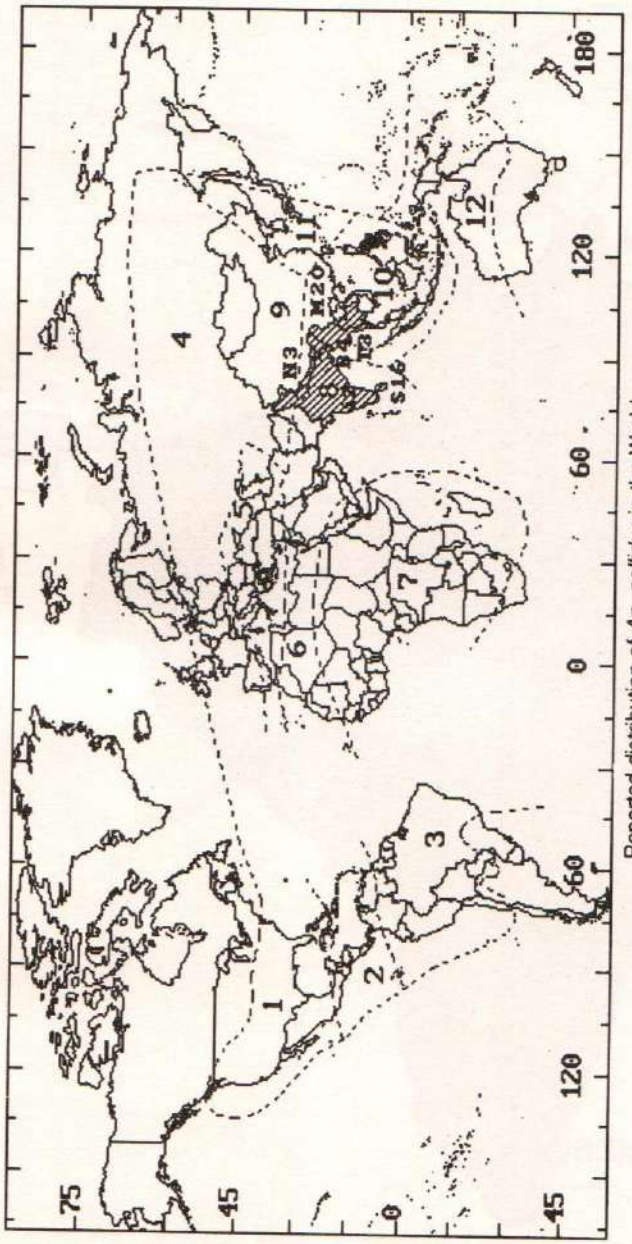
Anopheles pallidus

Name	:	*An. pallidus* Theobald, 1901. *A Monograph of the Culicidae or Mosquitoes,* **1:** 132–134
Derivative	:	Latin, *pallidus*, pale, ashen. Theobald described it as a variety but it is now accorded the full status of a species.
Type form	:	Available at the British Museum of Natural History, London.
Reported morphological variations	:	3 in maxillary palpi and 2 in leg.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Rests in houses and cattlesheds, and sometimes outdoors.
Breeding ecology	:	Breeds in tanks, ponds, ditches with vegetation, shallow pools in beds of streams, seepages, borrowpits, irrigation channels, wells, and fallow and growing ricefields.
Biting time	:	Before midnight.
Feeding preference	:	A zoophilic species but in the absence of cattle rapidly bites man.
Flight range	:	NA
Susceptibility to insecticides	:	Susceptible to DDT.
Relation to disease	:	Not a vector of malaria of any significance. Some gut- and gland-infected *Plasmodium* specimens were detected in India.
Reported distribution	:	Occurs in Bangladesh, Myanmar, India, Indonesia, Malaysia, Nepal, Sri Lanka, and Thailand. In India, recorded from Assam, Arunachal Pradesh, Andhra Pradesh, Bihar, Delhi, Gujarat, Goa, Haryana, Karnataka, Kerala, Manipur, Maharashtra, Madhya Pradesh, Orissa, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh, and West Bengal.
Vector incrimination	:	Results of studies made so far are summarized in the table.

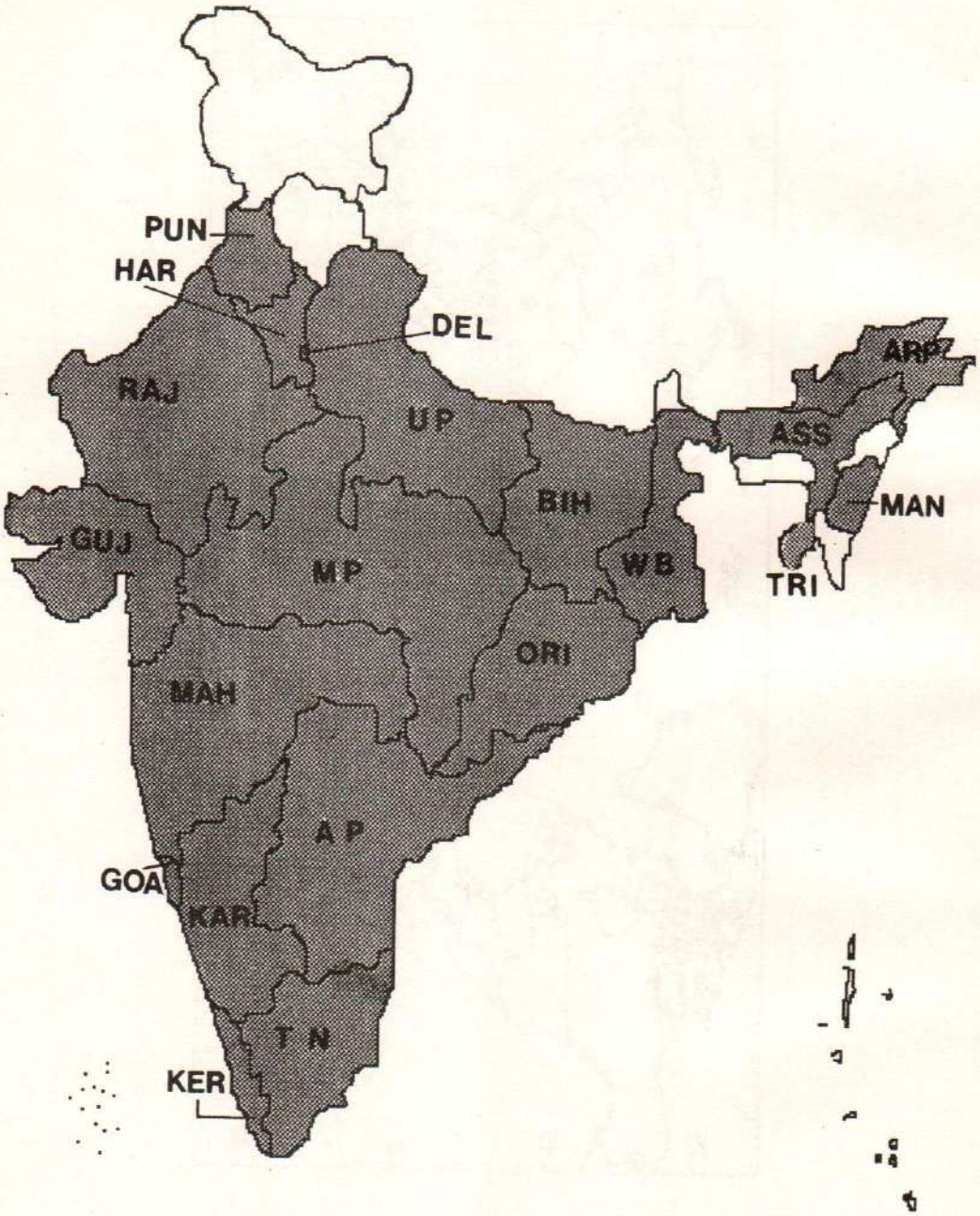
Table : *Anopheles pallidus*: Results of vector incrimination studies

Sl. No.	Year	Author	Locality	Number dissected	Number Positive		
					Gut	Gland	Total
1.	1929	Sur & Sur	Krishnagar, West Bengal	1232	0	3	3
2.	1931	Bose	West Bengal	1236	3	0	3
3.	1935	Timbers	Birbhum, West Bengal	35429	—	—	0.3%
4.	1935	Timbers	Birbhum, West Bengal	27238	0	9	9
5.	1939	Iyengar	Birbhum, West Bengal	254	2	0	2
6.	1939	Iyengar	West Bengal	508	0	20	20
7.	1940	Iyengar	West Bengal	408	2	0	2
8.	1940	Senior White & Adhikari	Satpura, Madhya Pradesh	3157	4	0	4
9.	1942	Roy & Biswas	Udaipur, Rajasthan	854	0	6	6
10.	1942	Roy & Biswas	Orissa	7513	60	0	60
11.	1943	Senior White *et al.*	Orissa	1409	1	0	1
12.	1944	Covell	West Bengal	403	1	0	1
13.	1944	Rao	Dhanbad, Bihar	NM	0.8%	0.1%	—
14.	1950	Viswanathan	Panchamahal, Gujarat	187	1	—	1

NM—Not mentioned.



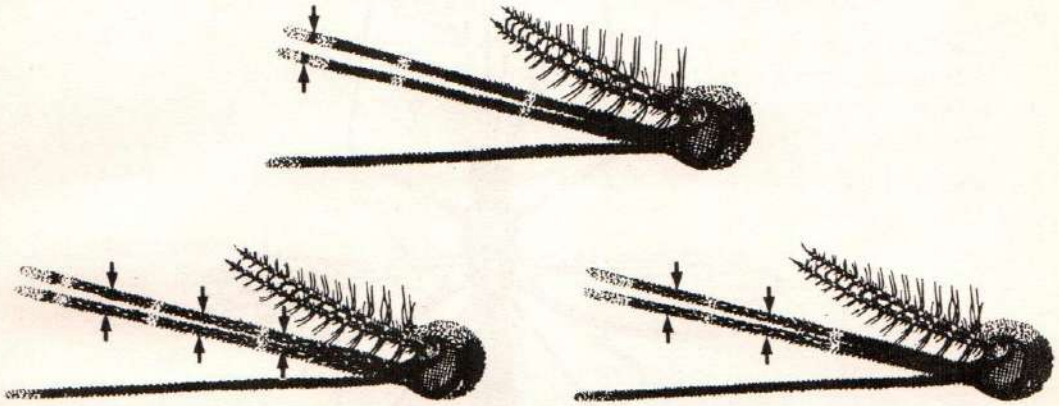
Reported distribution of *An. pallidus* in the World.



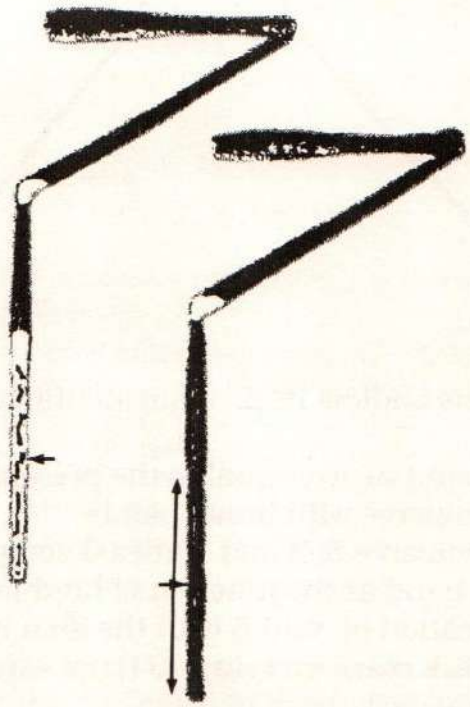
Reported distribution of *An. pallidus* in India.

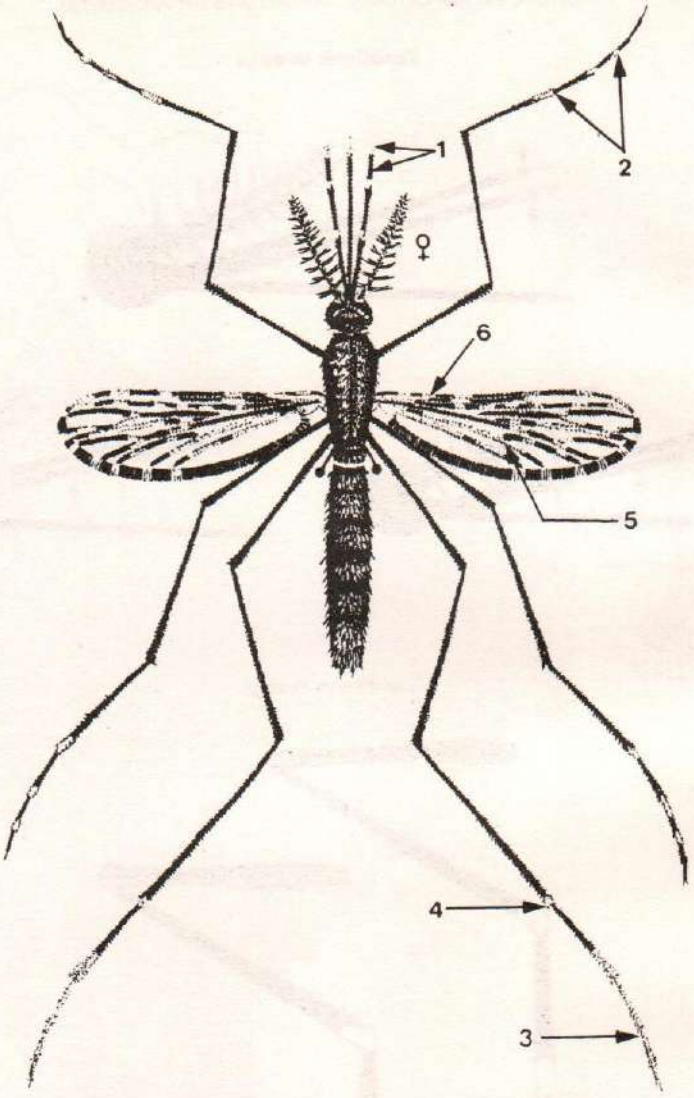
REPORTED IMPORTANT VARIATIONS OF *An. pallidus*

Variations in palpi



Variations in leg





An. philippinensis Ludlow 1902, main identification characters

1. Apical pale band nearly equal to the pre-apical dark band
2. Fore leg tarsomeres with broad bands
3. Hind leg tarsomeres 5, 4 and 3 atleast completely white.
4. A small pale band at the junction of hind tarsomeres 1 and 2
5. At the bifurcation of vein 5 (CU) the area is pale
6. Pre-sector dark mark on vein 1 (R1) not extending basally up to the humeral dark mark of costa

*Anopheles philippinensis**

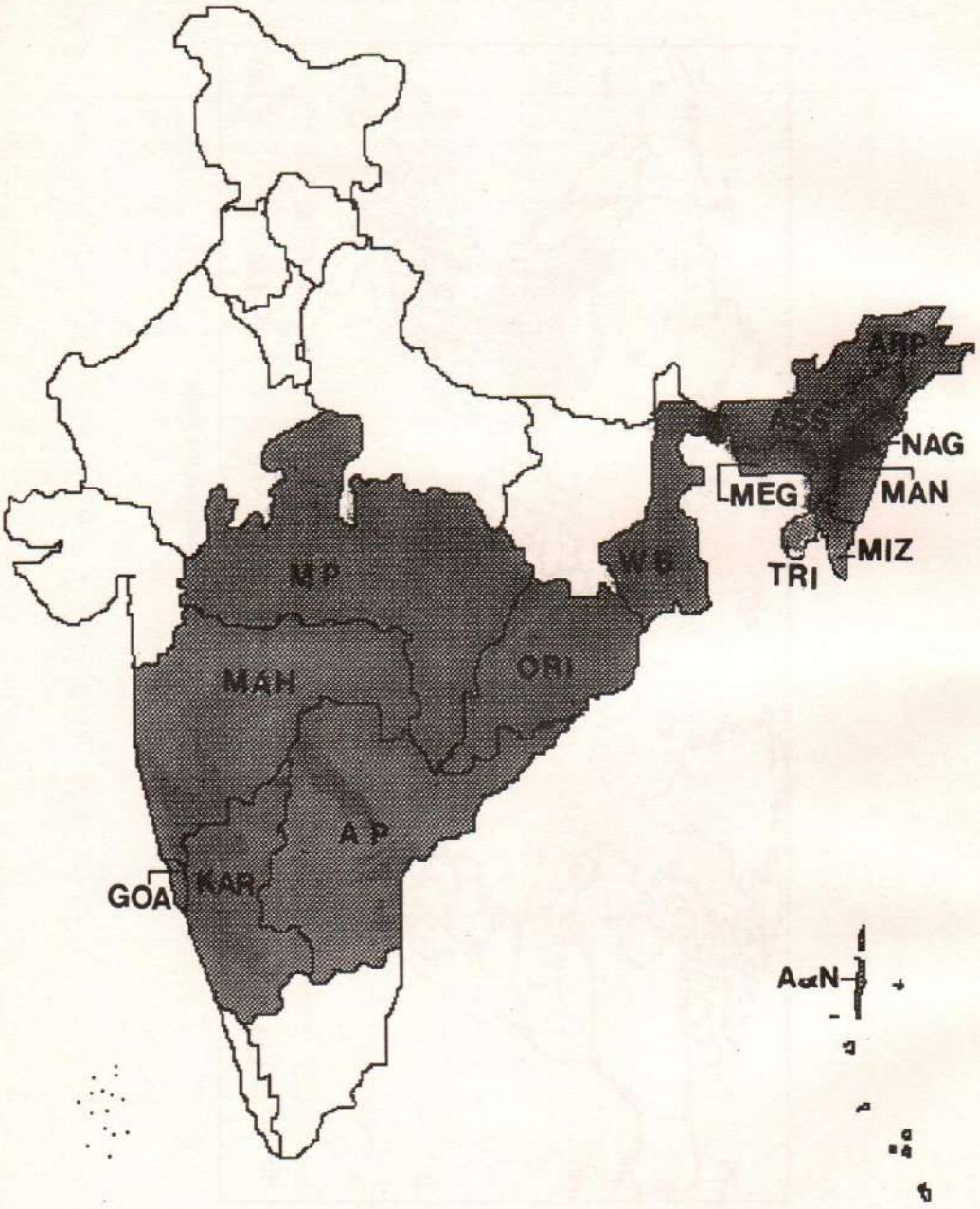
Name	:	*An. philippinensis* Ludlow, 1902. *The Journal of the American Medical Association.* **39:** 426–427.
Derivative	:	The species was collected during the course of Ludlow's Classification and Study of the Geographical Distribution of the Mosquitoes of the Philippine Islands and therefore the author named this species after the Philippine Islands.
Type form	:	Available at the United States National Museum, Washington, D.C.
Reported morphological variations	:	1 in maxillary palpi and 1 in leg
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Rests in human dwellings, cattlesheds and stables. Also rests outdoors on vegetation in forests.
Breeding ecology	:	Breeds in a variety of places particularly swamps, tanks, ponds, ditches, ricefields etc., generally with a good growth of vegetation in stagnant water. Also breeds in shaded parts of lakes, inundated nullahs and pools, borrowpits with vegetation, tree holes, leaf axils of plants and grassy edges of very slow running streams.
Biting time	:	Bites outdoors and indoors throughout night, with peaks between 20.00 and 22.00 hrs and 2.00 and 4.00 hrs.
Feeding preference	:	Predominantly zoophilic, also bites man.
Flight range	:	0.4–0.8 km.
Susceptibility to insecticides	:	Susceptible to DDT and HCH.
Relation to disease	:	A secondary vector of malaria in Bangladesh, India and Myanmar.
Reported distribution	:	Found in Bangladesh, Borneo, China, France, Hainan-Island, India, Indochina, Java, Malaya, Myanmar, the Philippines, and Sumatra. In India, recorded from Andaman Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Goa, Karnataka, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Tripura, and West Bengal.
Vector incrimination	:	Results of studies made so far are summarized in the table.

*The presence of this species yet to be confirmed in India. Studies so far have revealed that true *An. philippinensis* is not found in India and all specimens examined from Eastern India were *An. nivipes*.

Table : *Anopheles philippinensis*: Results of vector incrimination studies

Sl. No.	Year	Author	Locality	Number dissected	Number Positive		
					Gut	Gland	Total
1.	1929	Sur	West Bengal	223	3	5	8
2.	1929	Sur & Sur	Krishnagar, West Bengal	770	0	15	15
3.	1929	Sur & Sur	Birnagar, West Bengal	458	0	7	7
4.	1932	Bose	Birnagar, West Bengal	499	—	—	11
5.	1935	Timbers	Birbhum, West Bengal	12594	—	—	131
6.	1937	Niogi & Khan	West Bengal	101	0	2	2
7.	1939	Iyengar	West Bengal	1918	81	76	157
8.	1940	Iyengar	West Bengal (1 locality)	1830	68	65	133
9.	1940	Iyengar	West Bengal (10 localities)	3758	149	141	290
10.	1940	Krishnan	Burdwan, West Bengal	1053	—	—	89
11.	1941	Viswanathan *et al.*	Assam	4239	2	2	4
12.	1940	Iyengar	West Bengal	3165	149	126	275
13.	1944	Iyengar	Deltaic West Bengal	865	—	—	64
14.	1947	Ganguli	West Bengal	297	5	7	12
15.	1948a	Sen	West Bengal	1053	—	—	89
16.	1948a	Sen	Madhagram, Calcutta, West Bengal	180	—	—	12
17.	1976	Rajagopal	Burnihat, Meghalaya	174	0	1	1

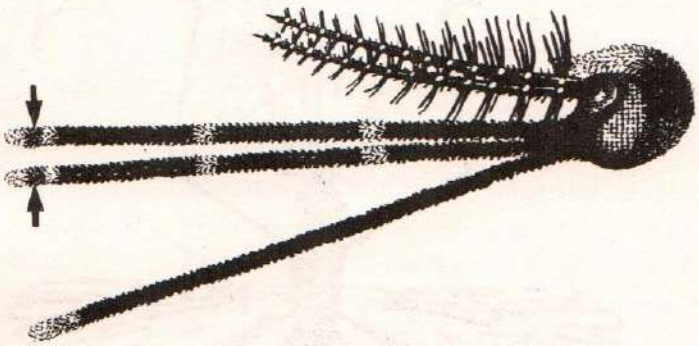
Reported distribution of *An. philippinensis* in the World.



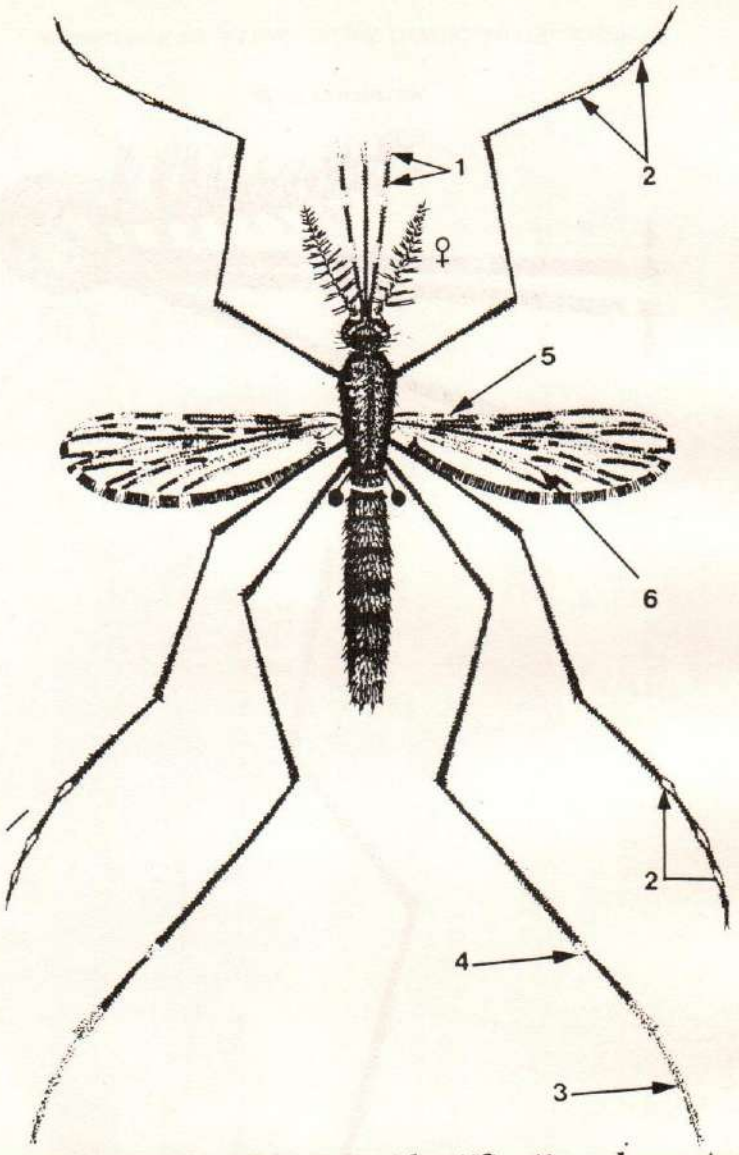
Reported distribution of *An. philippinensis* in India.

REPORTED IMPORTANT VARIATIONS OF *An. philippinensis*

Variation in palpi



Variation in leg

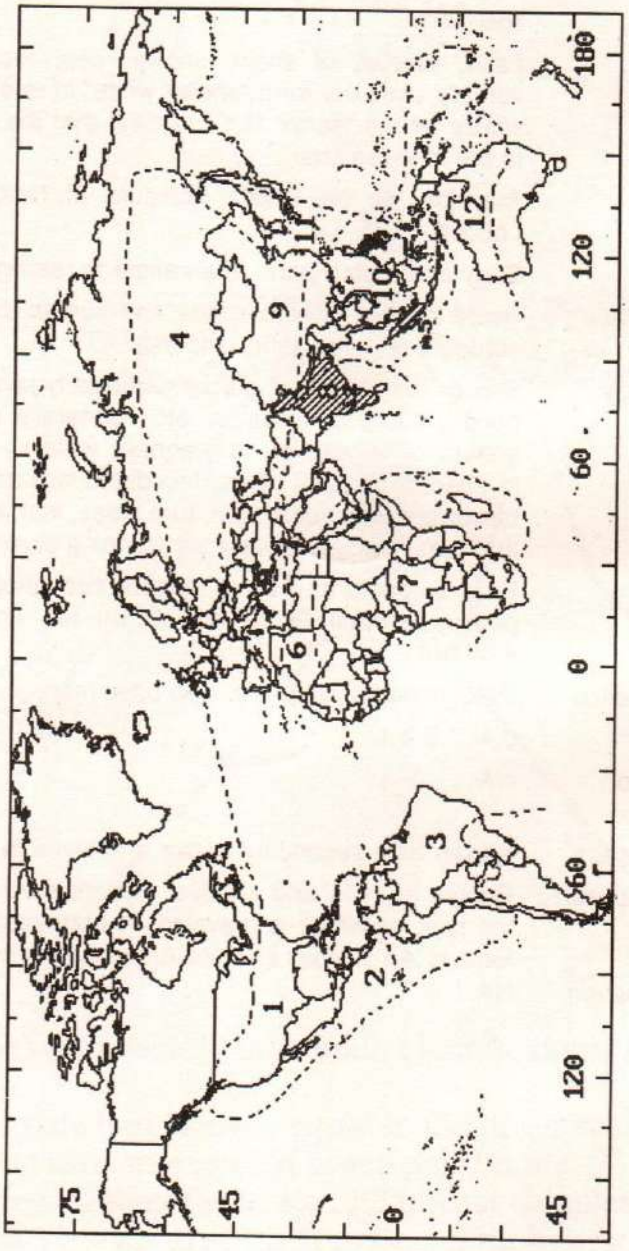


An. nivipes (Theobald) 1903, main identification characters

1. Apical pale band nearly equal to the pre-apical dark band.
2. Fore leg tarsomeres with broad pale bands.
3. Hind leg tarsomeres 5, 4 and 3 atleast completely white.
4. A small pale band at the junction of hind tarsomeres 1 and 2.
5. Pre-sector dark mark on vein 1 (R1) basally extended up to humeral dark mark of costa.
6. At the bifurcation of vein 5 (CU) the area is pale.

Anopheles nivipes

Name	:	*An. nivipes* (Theobald), 1903. *The Entomologist.* **36:** 256–259.
Derivative	:	Latin, *niveus,* of snow, snowy; *pes,* foot. Theobald actually uses the term "snowy white" in reference to the scales on the thorax, but it is clear that the name refers to the hind-leg tarsi.
Type form	:	Available at the British Museum of Natural History, London.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Rests indoors in cattlesheds and human dwellings and outdoors on vegetation in forests.
Breeding ecology	:	Breeds in a variety of places particularly swamps, tanks, ponds, ditches, ricefields, etc., generally with a good growth of vegetation in stagnant waters. Also breeds in shaded parts of lakes, inundated nullahs and pools, borrowpits with vegetation, tree holes, leaf axils of plants and grassy edges of very slowrunning streams.
Biting time	:	Bites outdoors as well as indoors throughout night, with peaks between 20.00 and 22.00 hrs and 2.00 and 4.00 hrs.
Feeding preference	:	Predominantly zoophilic, also bites man.
Flight range	:	0.4–0.8 km.
Susceptibility to insecticides	:	NA
Relation to disease	:	Known as a secondary vector of malaria in Malaya.
Reported distribution	:	Occurs in India and Malaya. Recent studies show that the species which is prevalent in northeastern states of India is *An. nivipes* and not *An. philippinensis.*
Vector incrimination	:	NA



Reported distribution of *An. nivipes* in the World.

ANDAMAN NICOBAR ISLANDS (A&N)
1. Andaman Islands

ARUNACHAL PRADESH (ARP)
1. Subansiri
2. Changlong
3. Tirap

ASSAM (ASS)
1. Kamrup
2. Dibrugarh

MANIPUR (MAN)
1. Imphal

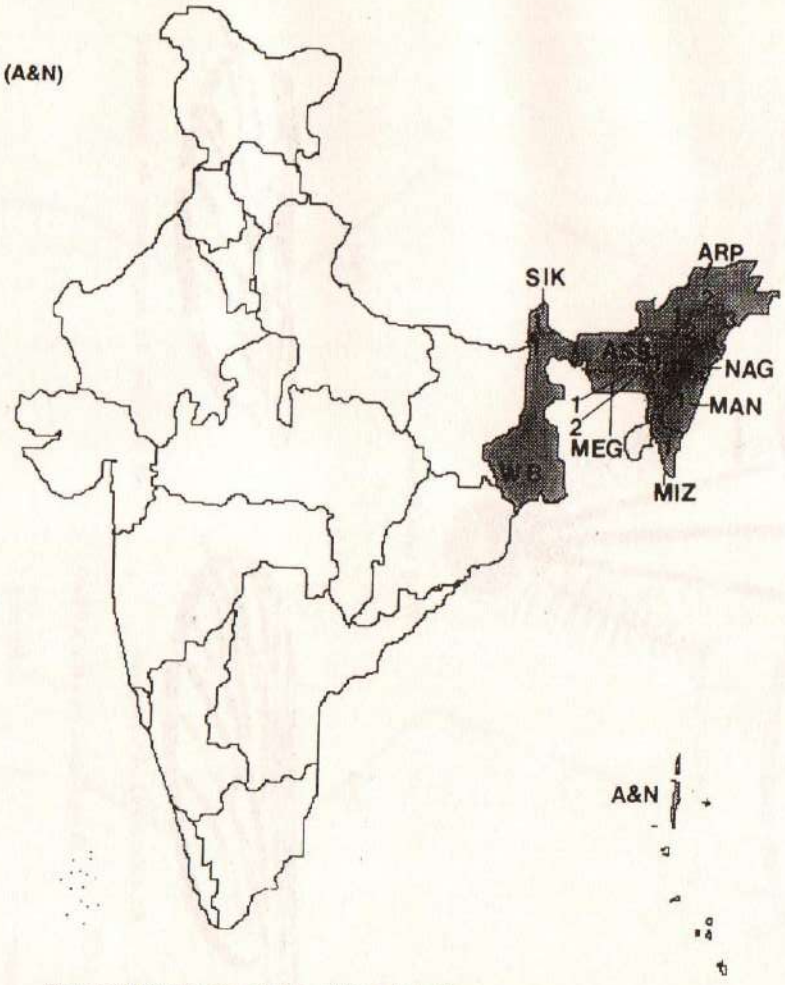
MEGHALAYA (MEG)
1. Burnihat
2. Shillong

MIZORAM (MIZ)
1. Aizwal

NAGALAND (NAG)
1. Kohima

SIKKIM (SIK)
1. Sikkim

WEST BENGAL (WB)
1. Darjeeling

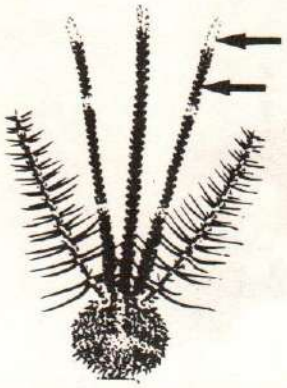


Reported Distribution of *An. nivipes* in India.

1.3 An. culicifacies, An. fluviatilis, An. jeyporiensis, An. sergentii, An. moghulensis

Wing with 4 or more pale areas on the costa, subcosta including vein 1(R1)

Palpi with three pale bands, apical pale band nearly equal to the pre-apical dark band



Wing vein 3(R4+5)

Dark

An. culicifacies, An. sergentii

Pale

An. fluviatilis, An. moghulensis, An. jeyporiensis

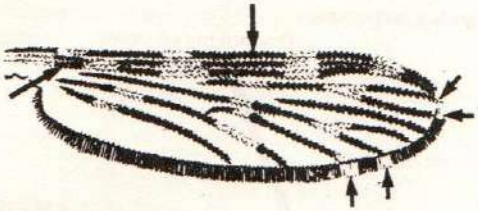
Fringe spot on vein 3(R4+5)

Absent	Present
An. culicifacies	*An. sergentii*

Other characters

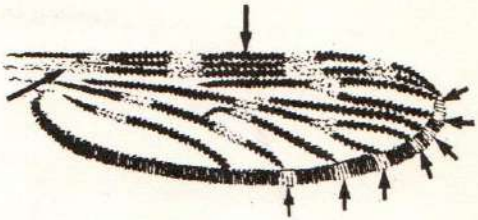
Main dark costal spot longer than the dark spot of vein 1(R1) and subcosta	Main dark costal spot equally long as on vein 1(R1) and subcosta
Vein 1(R1) interrupted by a dark spot in basal area	Vein 1(R1) completely pale at basal area
Fringe spot present on veins 2.1(R2), 2.2(R3), 4.2(M2) and 5.1(Cu1)	Fringe spot present on veins 2.1(R2), 2.2(R3), 3(R4+5), 4.1(M1), 4.2(M2), 5.1(Cu1) and 5.2(Cu2)

An. culicifacies



Legs without any banding

An. sergentii

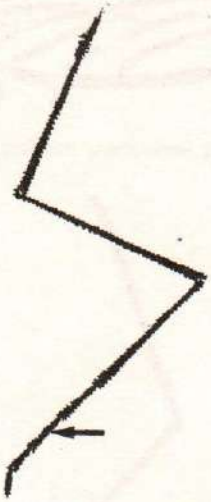


Legs without any banding

An. fluviatilis, An. jeyporiensis, An. moghulensis

Banding on foreleg tarsomeres

Absent



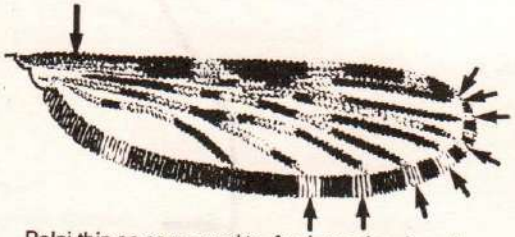
Present (small bands)

An. jeyporiensis,
An. moghulensis

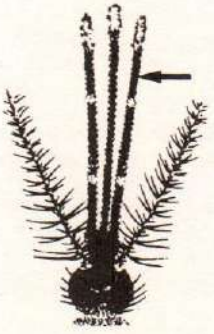
Other characters

Inner costa completely dark

Fringe spot present on all the veins except on vein 6(Anal)



Palpi thin as compared to *An. jeyporiensis* and *An. moghulensis*



An. fluviatilis

An. jeyporiensis, An. moghulensis

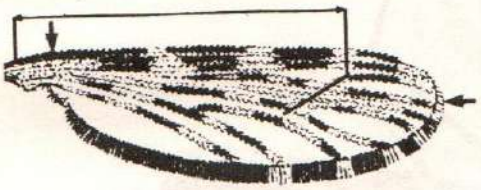
The distance of the anterior forked cell from the base of the costa compared to that of the posterior forked cell from the base of the costa.

More
An. moghulensis

Less
An. jeyporiensis

Other characters

Inner costa completely dark
Apex of wing usually extremely pale
Fringe spot absent on wing vein 6(Anal)

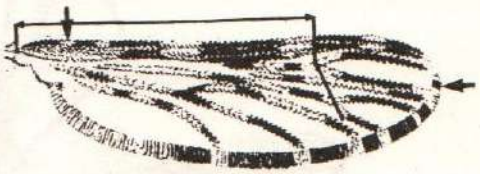


Palpi thick and long as compared to *An. fluviatilis*

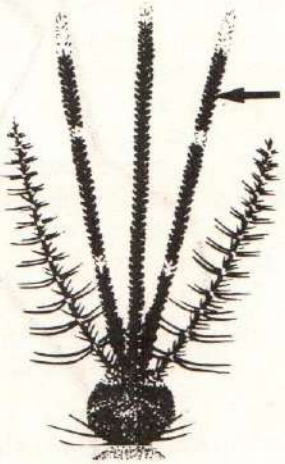
Mesonotum with broad scales and with a line of broad overlapping scales at the sides in front of wing root

An. moghulensis

Inner costa interrupted
Apex of wing not extremely pale
Fringe spot present on wing vein 6(Anal)



Palpi thick and long as compared to *An. fluviatilis*



Mesonotum with narrow scales forming a tuft in median area

An. jeyporiensis

An. culicifacies Giles 1901, main identification characters

1. Apical pale band nearly equal to the pre-apical dark band.
2. Tarsomeres without bands
3. Vein 3 (R4+5) mainly dark
4. Inner costa interrupted

Anopheles culicifacies

Name	:	*An. culicifacies* Giles, 1901. *Entomologists' Monthly Magazine,* **37:** 196–198.
Derivative	:	Latin, *culex* (genitive, *culicis*), a gnat, midge; *facies*, external form, look, appearance, aspect. It mimics *Culex fatigans* (-*Culex quinquefasciatus*) when resting, especially the females rest/sit 'humped up' in exactly the same way as those of the genus *Culex* and therefore named *An. culicifacies*.
Type form	:	Available at the British Museum of Natural History, London.
Reported morphological variations	:	8 in maxillary palpi and 11 in wing
Species complex	:	Four sibling species (known as A, B, C and D).
Sitting posture	:	Body parallel to resting surface.
Resting habit	:	Prefers to rest in cattlesheds and houses during the day. The species was also collected from straw, mudcakes, etc. near stables and from dense vegetation, under the bushes and in tree holes, an indication of outdoor resting.
Breeding ecology	:	Prefers to breed in river margins, river-bed pools, canal systems, seepage waters from canals and dams, rainwater collections in borrowpits, or in any lowlying grounds and shoreline pockets in dams and lakes. Also breeds in hoof marks and wheel ruts, ricefields, wells, ponds, pools of water supply systems, and brackish-water pools.
Biting time	:	Throughout night but peak biting occurs between 19.00 and 4.00 hours with variations from place to place.
Feeding preference	:	The species is predominantly zoophilic, a wide range of variation found in anthropophily.
Flight range	:	1–3 km.
Susceptibility to insecticides	:	Resistant to DDT, and HCH in many parts of the country. Also resistant to malathion in Gujarat and Maharashtra and a few other areas.
Relation to disease	:	Efficient vector of human malaria in India and neighbouring countries, e.g., Afghanistan, Iran, Muscat, Myanmar, Nepal, Pakistan, and Sri Lanka. Recently *W. bancrofti* larvae were detected in this species from Shahjahanpur (U.P.), India.
Reported distribution	:	Occurs very widely, i.e. from Afghanistan, Bahrain, Bangladesh, India, Indochina, Iran, Muscat, Myanmar, Nepal, Pakistan, Southern China, Sri Lanka, Trucial Oman and Thailand. In India, recorded throughout the country except Andaman & Nicobar Islands.
Vector incrimination	:	Results of studies made so far are summarized in the table.

Table : *Anopheles culicifacies*: Results of vector incrimination studies

Sl. No.	Year	Author	Locality	Number dissected	Number Positive		
					Gut	Gland	Total
1.	1902	Stephens & Christophers	Ennore, Tamil Nadu	69	0	6	6
2.	1902	Stephens & Christophers	Punjab	252	0	11	11
3.	1902	Cornwall	Ennore, Tamil Nadu	25	0	4	4
4.	1910	Graham	Kosi, Uttar Pradesh	134	2	2	4
5.	1910	Graham	Kairana, Haryana	128	1	0	1
6.	1912	Ross	Ennore, Tamil Nadu	85	0	1	1
7.	1913	Ross	Cuddapah, Tamil Nadu	200	2	0	2
8.	1913	Graham	Meerut, Uttar Pradesh	211	1	0	1
9.	1913	James & Gunasekara	Talimannar	36	0	1	1
10.	1914	Kenrick	Cent. Prov., (Madhya Pradesh)	675	0	2	2
11.	1914	Horne	Penukonda	16	0	1	1
12.	1914a	Hodgson	Delhi, Union Territory	111	3	0	3
13.	1915	Mhaskar	N. Kanara, Karnataka	837	6	2	8
14.	1915	Rao	Hospet	116	0	2	2
15.	1915	Rao	Ramnad, Tamil Nadu	44	2	0	2
16.	1925	Krishnan	Vizagapatnam, Andhra Pradesh	31	1	0	1
17.	1925	Sinton	Mani Majra	6	1	0	1
18.	1925	Ayer	Sappal Hill	98	0	1	1
19.	1927	Iyer	Bimlipatam	37	4	0	4
20.	1927	Covell	Ennore, Tamil Nadu	81	0	1	1
21.	1927	Covell	Hospet	128	—	—	2
22.	1927	Covell	Kanara, Karnataka	837	6	2	8
23.	1927	Covell	Ramnad, Tamil Nadu	44	—	—	2
24.	1927	Covell	Penukonda, Andhra Pradesh	16	0	1	1
25.	1927	Covell	Vizagapatam, Andhra Pradesh	31	1	0	1
26.	1928	Mayne	Saharanpur, Uttar Pradesh	2021	2	3	5
27.	1928	Gill	Punjab	57	0	2	2
28.	1929	King & Krishnan	Udayagiri, Tamil Nadu	42	4	1	5
29.	1929	Venkataraman	Vizagapatnam, Andhra Pradesh	186	3	0	3
30.	1929	Rao	Nandyal, Andhra Pradesh	68	1	1	2
31.	1929	King & Iyer	Mopad, Madras, Tamil Nadu	297	18	4	22
32.	1929	Iyer	Udayagiri, Tamil Nadu	52	1	1	2
33.	1931	Sweet & Rao	Kolar, Karnataka	4	0	2	2
34.	1931	Macdonald & Majid	Karnal, Punjab	NM	9.8%	0	—
35.	1931	Sweet & Rao	Mysore, Karnataka	5748	1	7	8
36.	1934	Nursing *et al.*	Nagenhalli	271	4	0	4

(Contd.)

Table : *Anopheles culicifacies*: Results of vector incrimination studies (Contd.)

Sl. No.	Year	Author	Locality	Number dissected	Number Positive		
					Gut	Gland	Total
37.	1934	Nursing *et al.*	Mysore, Karnataka	1964	46	14	60
38.	1934	Nursing *et al.*	Hariyur, Karnataka	447	4	2	6
39.	1934	Nursing *et al.*	Mandya, Karnataka	1151	26	12	38
40.	1934	Iyengar	Travancore, Kerala	984	0	1	1
41.	1934	Ahuja	Ajmer, Rajasthan	53	4	2	6
42.	1936	Viswanathan	Madakasira	70	2	2	4
43.	1936	Lamprell	Lumding, Assam	516	0	4	4
44.	1937c	Senior White	Chatikona, Orissa	1168	2	0	2
45.	1937c	Senior White	Jeypore hills, Orissa	4744	3	0	3
46.	1937	Hicks & Majid	Karnal, Haryana	8850	20	32	52
47.	1937	Sweet	T. Narsipur (Mysore, Karnataka)	1191	45	8	53
48.	1937	Niogi & Khan	Sylee (Dooar), North Bengal	124	0	1	1
49.	1937c	Senior White	Lanjigarh Road (Jeypore hills) Orissa	1067	1	0	1
50.	1937	Ramsay	Dharbanga, Bihar	2988	2	2	4
51.	1938	Covell *et al.*	Delhi	2507	1	2	3
52.	1938	Senior White	Jeypore hills, Orissa	2446	2	0	2
53.	1938	Russell *et al.*	Madras, Tamil Nadu	6484	4	5	9
54.	1938	Barber & Rice	Poona, Maharashtra	1016	0	3	3
55.	1938	Senior White & Das	Singhbhum hills, Bihar	1611	5	0	5
56.	1938	Ramsay	Peermade	401	14	8	22
57.	1939	Russell & Jacob	Ennore, Madras Tamil Nadu	984	7	1	8
58.	1939	Sundaresan	Baruva, Orissa	122	1	0	1
59.	1939	Mathew	Travancore, Kerala	1131	6	3	9
60.	1940	Russell & Rao	Madras, Tamil Nadu	13156	8	8	16
61.	1940	Senior White	Chota Nagpur, Bihar	7482	15	0	15
62.	1940	Senior White	Kesinga, Orissa	129	1	0	1
63.	1940	Senior White	Khodri, Satpura, Madhya Pradesh	700	1	0	1
64.	1940	Senior White	Khongsara, Satpura, Madhya Pradesh	1317	2	0	2
65.	1940	Senior White	Balghara	541	1	0	1
66.	1940	Senior White	Bhadrak, Orissa	119	1	0	1
67.	1940	Senior White	Bhanwar Tank	426	1	1	2
68.	1940	Senior White	Paniyajobi	425	1	0	1
69.	1940	Senior White & Narayana	Singhbhum hills, Bihar	236	1	0	1
70.	1940	Senior White & Adhikari	Satpura ranges, Madhya Pradesh	909	0	2	2
71.	1941	Anderson & Viswanathan	Lumding, Assam	1232	2	5	7
72.	1942	Roy & Biswas	Dharamjoi Garh	969	0	5	5
73.	1943	Singh & Jacob	Ahmedabad, Gujarat	234	0	1	1
74.	1943	Covell & Jaswant Singh	Delhi, Union Territory	9628	19	19	38

(Contd.)

Table : *Anopheles pallidus*: Results of vector incrimination studies (Contd.)

Sl. No.	Year	Author	Locality	Number dissected	Number Positive		
					Gut	Gland	Total
75.	1943	Senior White	Hazaribagh, Bihar	9571	16	2	18
76.	1943	Senior White *et al.*	Orissa coastal plain	735	1	0	1
77.	1943	Bombay Malaria Organization	Thane, Maharashtra	174	—	—	1
78.	1943	Senior White & Venkata Rao	Vizagapatnam, Andhra Pradesh	6608	3	1	4
79.	1943	Senior White & Rao	Vizagapantam, Andhra Pradesh	179	1	1	2
80.	1944	Rao	Dhanbad, Bihar	1509	9	2	11
81.	1945	Soman	Bombay, Maharashtra	629	1	0	1
82.	1945	Senior White *et al.*	Delhi, Union Territory	906	2	0	2
83.	1945	Pal	Delhi, Union Territory	665	0	10	10
84.	1945	Subbarao & Appa Rao	Vizagapatnam (Urban), Andhra Pradesh	844	1	2	3
85.	1945	Subbarao & Appa Rao	Vizagapatnam (Rural), Andhra Pradesh	1377	1	1	2
86.	1946	Senior White &Ghosh	West Bengal	3041	1	0	1
87.	1946	De Burca	Central Provinces, (Madhya Pradesh)	424	6	6	12
88.	1946c	Senior White	Dongargarh (Satpura)	4816	1	1	2
89.	1946	De Burca	Jabalpur, Madhya Pradesh	166	4	4	8
90.	1946	De Burca	Mhow, Madhya Pradesh	258	1	1	2
91.	1946	Rao *et al.*	Madras, Tamil Nadu	8357	9	4	13
92.	1948	Godbole *et al.*	Bombay, Maharashtra	3453	—	—	9
93.	1948	Subramanian & Dixit	Cen. Prov., (Madhya Pradesh)	7337	0	16	16
94.	1949	Raghavan & Krishnan	Madras, Tamil Nadu	54	1	0	1
95.	1949	Bhatt	Nasik Distt., Maharashtra	3675	0	4	4
96.	1950	Viswanathan	Ahmedabad, Gujarat	737	4	2	6
97.	1950	Viswanathan	Bijapur, Karnataka	3463	10	12	22
98.	1950	Subramanian & Gupta	Dharamjaigarh, Madhya Pradesh	2277	0	2	2
99.	1950	Jacob	Jammu & Kashmir	1021	3	3	6
100.	1950	Viswanathan	Nasik, Maharashtra	10057	1	1	2
101.	1950	Viswanathan	Poona, Maharashtra	400	1	1	2
102.	1950	Viswanathan	Dharwar, Maharashtra	119	—	—	4
103.	1950	Viswanathan	Kaira, Maharashtra	1343	1	2	3
104.	1950	Viswanathan	East Khandesh, Maharashtra	2786	—	—	7
105.	1953	Issaris *et al.*	Terai, Uttar Pradesh	5742	0	5	5
106.	1957	Bhatia *et al.*	Udaipur, Rajasthan	255	0	1	1

(Contd.)

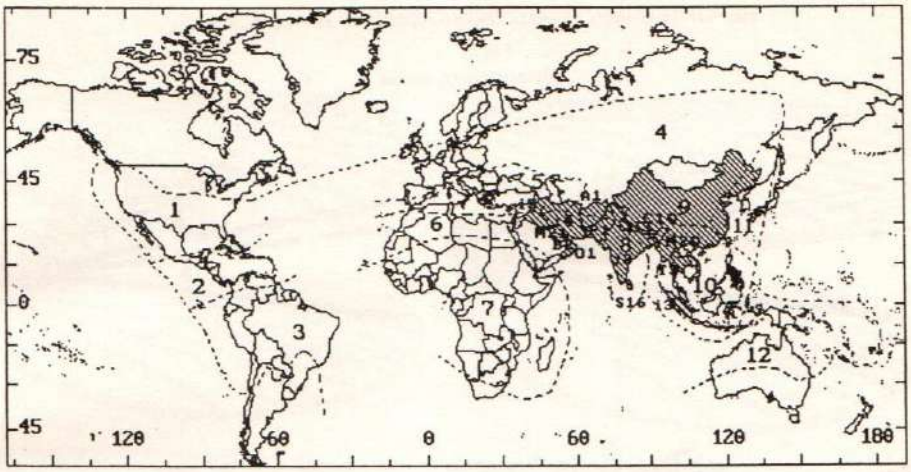
Table : *Anopheles culicifacies*: Results of vector incrimination studies (Contd.)

Sl. No.	Year	Author	Locality	Number dissected	Number Positive		
					Gut	Gland	Total
107.	1958a	Bhatia *et al.*	Khurja, Bulandshahar Uttar Pradesh	634	0	1	1
108.	1974	Vaid *et al.*	Ratlam, Madhya Pradesh	209	0	1	1
109.	1977	Pattanayak *et al.*	Delhi, Union Territory	1058	0	2	2
110.	1978	Sitaraman *et al.*	Rameswaram Island, Tamil Nadu	91	0	1	1
111.	1979	Rahman *et al.*	Alwar, Rajasthan	798	0	3	3
112.	1980	Annual Report, NICD	Jagdalpur	19571	1	3	4
113.	1980	Subba Rao *et al.*	Okhla, Delhi Union Territory	17	0	1	1
114.	1980	Subba Rao *et al.*	Mandora, Haryana	120	0	1	1
115.	1982	Annual Report, MRC	Kharkhoda PHC, Haryana	1254	0	1	1
116.	1982	Ansari *et al.*	Basantpur, Haryana	38	1	0	1
117.	1982a	Choudhury & Ghosh	Kharkhoda PHC, Haryana	1862	0	19	19
118.	1983	Choudhury	Delhi, Union Territory	812	0	8	8
119.	1983	Choudhury	Ghaziabad, Uttar Pradesh	814	0	10	10
120.	1983	Choudhury	Kharkhoda PHC, Haryana	8447	0	83	83
121.	1983	Choudhury *et al.*	Gadarpur, Uttar Pradesh	1598	0	21	21
122.	1983–84	Annual Report, MRC	Arthala, Uttar Pradesh	333	0	8	8
123.	1983–84	Annual Report, MRC	Basantpur, Haryana	841	0	1	1
124.	1983–84	Annual Report, MRC	Delhi, Union Territory	633	0	3	3
126.	1983–84	Annual Report, MRC	Bhanera, Ghaziabad Uttar Pradesh	1021	0	5	5
127.	1983–84	Annual Report, MRC	Ghaziabad, Uttar Pradesh	760	0	14	14
128.	1983–84	Annual Report, MRC	Raipur, Uttar Pradesh	227	0	1	1
129.	1983–84	Annual Report, MRC	Khanpur, Uttar Pradesh	134	0	1	1
130.	1983–84	Annual Report, MRC	Maseet Uttar Pradesh	54	0	1	1
131.	1983	Choudhury	Ghaziabad, Uttar Pradesh	1089	0	14	14
132.	1983	Choudhury	Delhi, Union Territory	1528	0	3	3
133.	1983–1984	Annual Report, MRC	Gadarpur, Uttar Pradesh	1730	0	3	3
134.	1984	Ansari *et al.*	Bareilly, Uttar Pradesh	243	0	2	2

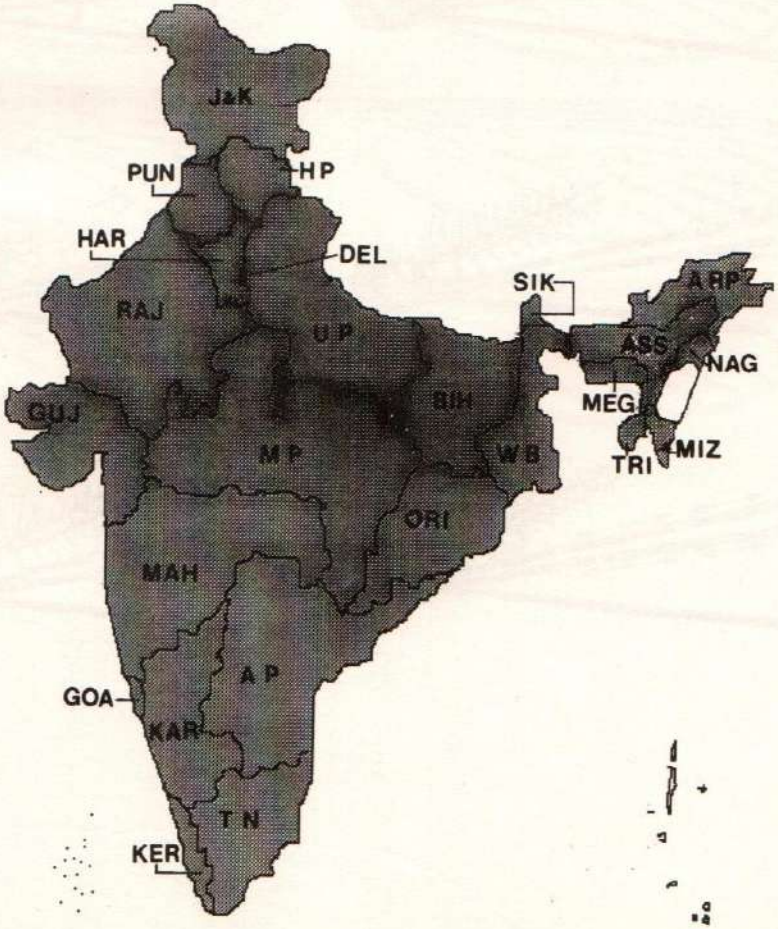
(Contd.)

Table : *Anopheles pallidus*: Results of vector incrimination studies (Contd.)

Sl. No.	Year	Author	Locality	Number dissected	Number Positive		
					Gut	Gland	Total
135.	1984	Mani *et al.*	Tamil Nadu	3267	7	13	20
136.	1984	Sabesan *et al.*	Rameswaram Island, Tamil Nadu	4371	3	21	24
137.	1984-85	Annual Report, MRC	Bulandshahar, Uttar Pradesh	386	0	2	2
138.	1984-85	Annual Report, MRC	Bhanera Loni Ghaziabad, Uttar Pradesh	4147	0	9	9
139.	1984-85	Annual Report, MRC	Ghaziabad, Uttar Pradesh	3356	0	14	14
140.	1984-85	Annual Report, MRC	Mandora, Haryana	9124	0	83	83
141.	1984-85	Annual Report, MRC	Kichha, Uttar Pradesh	1050	0	2	2
142.	1985	Sharma *et al.*	Shahjahanpur, Uttar Pradesh	232	0	1	1
143.	1985-86	Annual Report, MRC	Delhi, Union Territory	163	0	1	1
144.	1985-86	Annual Report, MRC	Ghaziabad, Uttar Pradesh	3112	0	9	9
145.	1985-86	Annual Report, MRC	Bulandshahar, Uttar Pradesh	2483	0	16	16
146.	1985-86	Annual Report, MRC	Gadarpur, Uttar Pradesh	400	0	2	2
147.	1986	Nagpal & Sharma	Ganjam, Orissa	100	2	0	2
148.	1986	Nagpal & Sharma	Balangir, Orissa	72	0	1	1
149.	1986	Nagpal & Sharma	Cuttack, Orissa	309	1	2	3
150.	1986	Nagpal & Sharma	Phulbani, Orissa	69	0	1	1
151.	1986	Nagpal & Sharma	Sambalpur, Orissa	127	0	1	1
152.	1986	Ansari *et al.*	Jangethi, Meerut, Uttar Pradesh	816	0	4	4
153.	1987	Subba Rao *et al.*	Arthala, Uttar Pradesh	460	0	8	8
154.	1987	Subba Rao *et al.*	Basantpur, Haryana	243	0	1	1
155.	1988	Annual Report, MRC	Dadri, Ghaziabad, Uttar Pradesh	95	0	1	1
156.	1988	Annual Report, MRC	Bulandshahar/ Rajaranipur, Uttar Pradesh	165	0	1	1
157.	1988	Annual Report, MRC	Bulandshahar Gopalpur, Uttar Pradesh	132	0	1	1
158.	1988	Annual Report MRC	Bulandshahar Dhanpur, Uttar Pradesh	128	0	2	2
159.	1989	Gunasekaran *et al.*	Koraput, Orissa	8995	5	0	5
160.	1990	S & T Project Report	Shahjahanpur, Uttar Pradesh	4958	0	6	6
161.	1990	Prasad & Sharma	Banda, Shahjahanpur, Uttar Pradesh	69	0	2	2
162.	1990	Kulkarni	Bastar, Madya Pradesh	36278	1	3	4
163.	1991	Neeru Singh & Gyanchand	Mandla, Madhya Pradesh	220	0	1	1



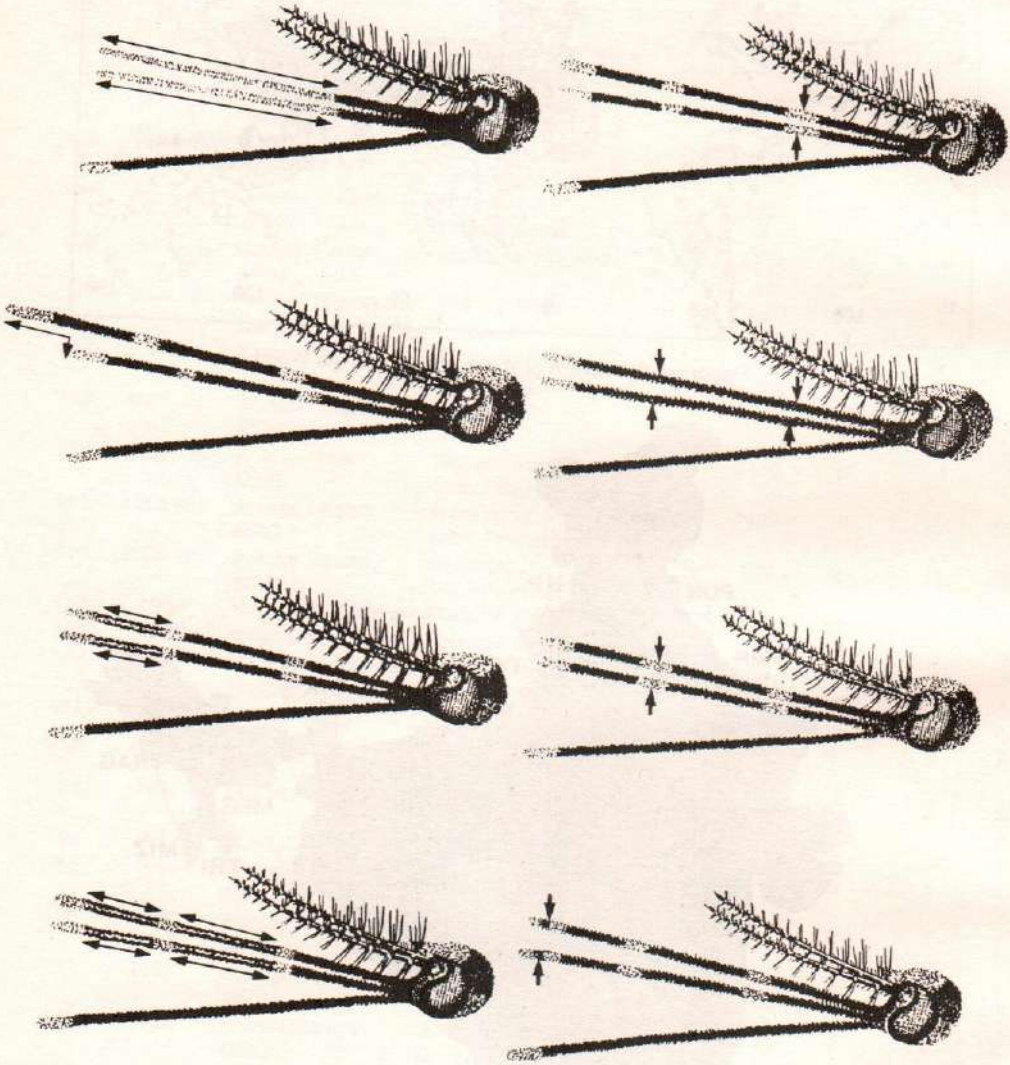
Reported distribution of *An. culicifacies* in the World.



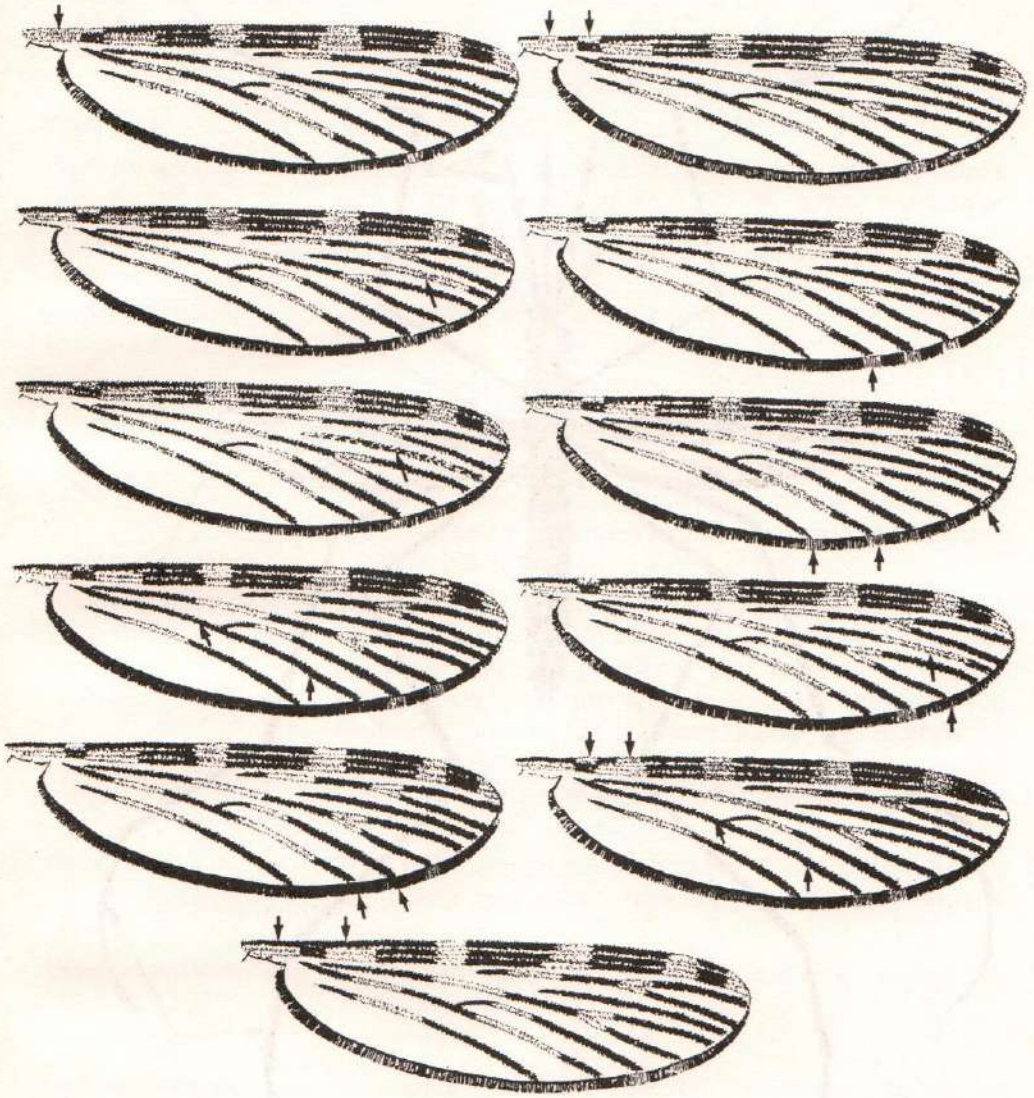
Reported distribution of *An. culicifacies* in India.

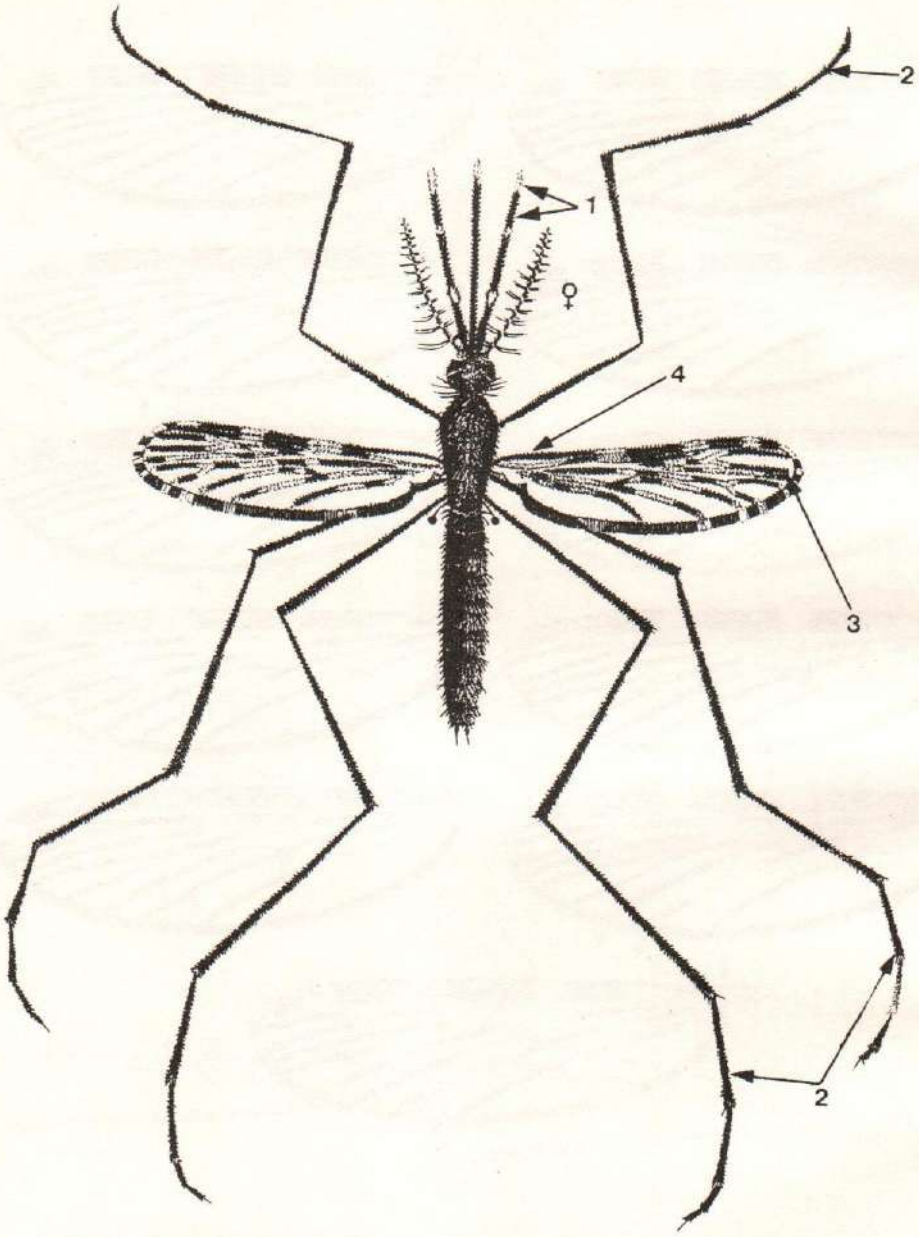
REPORTED IMPORTANT VARIATIONS OF *An. culicifacies*

Variations in palpi



Variations in wing





An. fluviatilis James 1902, Main identification characters

1. Apical pale band nearly equal to the pre-apical dark band.
2. Tarsomeres without bands.
3. Vein 3 (R4+5) mainly pale.
4. Inner costa completely dark.

Anopheles fluviatilis

Name	:	*An. fluviatilis* James, 1902. *Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India* (New Series), **2**: 106.
Old name	:	*An. listoni* Liston.
Derivative	:	Latin, *fluviatilis*, of rivers. James in all probability chose this name because he collected its larvae from clear streamlets with grassy edges.
Type form	:	Location not known.
Reported morphological variations	:	4 in maxillary palpi and 4 in wing.
Species complex	:	Three sibling species. (known as S, T and U).
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Adults of the species usually rest in human dwellings and to a lesser extent in cattlesheds during the day. The species also rests outdoors. Collected from an altitude of 1,060 to 3,340 m in Gum Valley of Nepal.
Breeding ecology	:	Preference for breeding places with a perceptible flow of water such as field channels, slow-moving streams, seepage channels of dams, and irrigation channels. Breeding is also recorded in shallow wells, tanks, ricefields (growing and fallow) along the foothills or undulating terrains, swamps, borrowpits during monsoon period when streams and channels are flushed by heavy rains.
Biting time	:	Peak biting activity occurs between 20.00 and 24.00 hrs, but timing may differ depending on the season and location.
Feeding preference	:	A predominantly anthropophilic species, sometimes feeds on cattle also.
Flight range	:	About 1 km.
Susceptibility to insecticides	:	Susceptible to DDT, except for a few reports of developing resistance to DDT from Pandharpur and Kurduwadi in Maharashtra.
Relation to disease	:	One of the most efficient vectors of malaria particularly in hills and foothills in India, Iran, Nepal, and Pakistan.
Reported distribution	:	Extensively found in the oriental regions and parts of West Asian subregion, Afghanistan, East and South Arabia, Bahrain, Iran, Iraq, Kazakh (USSR), Oman, and Pakistan. In oriental regions it occurs in Afghanistan, Bangladesh, South China, India, Indochina, Myanmar,

Nepal, Pakistan, Taiwan, and Thailand. In India, occurs in all mainland zones in Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh Terai, and West Bengal.

Vector incrimination : Results of studies made so far are summarized in the table.

Table : *Anopheles fluviatilis*: Results of vector incrimination studies

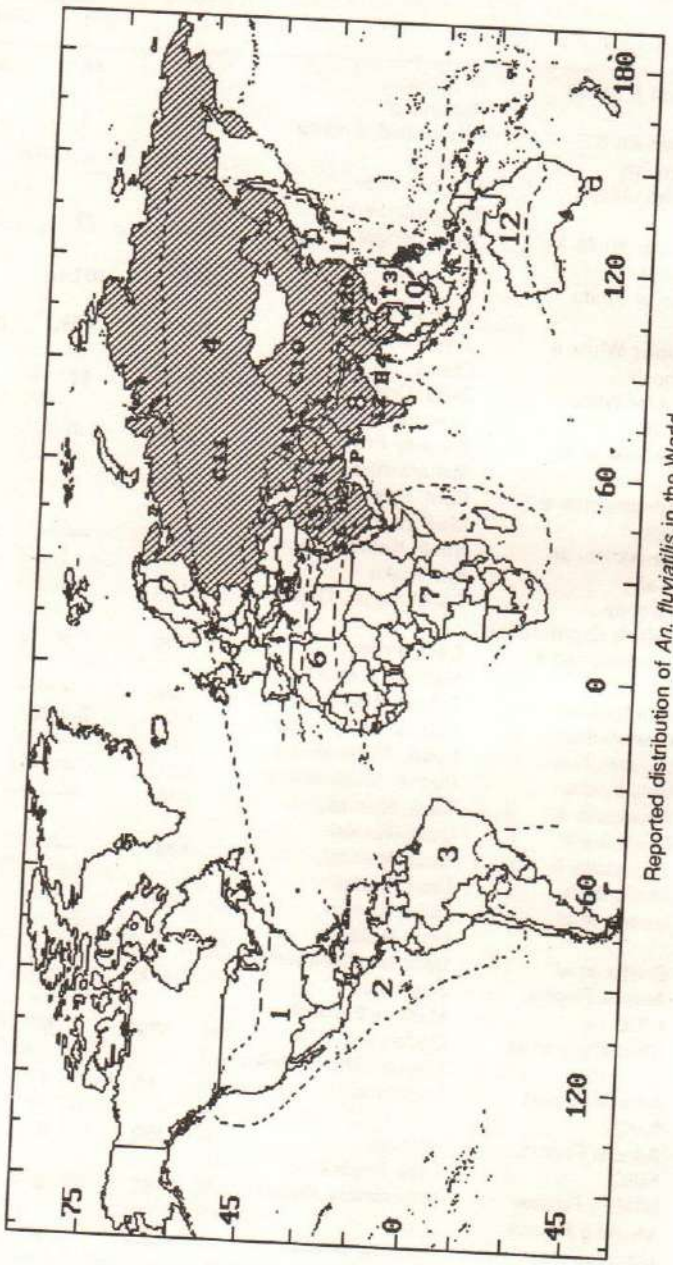
Sl. No.	Year	Author	Locality	Number dissected	Number Positive		
					Gut	Gland	Total
1.	1902	James	Assam	NM	—	—	6%
2.	1914	Perry	Jeypore, Orissa	273	0	4	4
3.	1923	Challam	Assam	315	0	12	12
4.	1927	Covell	Wynaad, Kerala	30	—	—	2
5.	1929	King & Iyer	Mopad, Madras, Tamil Nadu	77	3	0	3
6.	1931	Macdonald & Majid	Karnal, Haryana	23	2	0	2
7.	1934	Measham & Choudhury	Anaimallai hills, Tamil Nadu	203	10	8	18
8.	1937c	Senior White	Jeypore, Orissa	1111	80	39	119
9.	1938	Senior White	Jeypore, Orissa	760	52	23	75
10.	1938	Senior White & Das	Singhbhum hills, Bihar	1031	47	18	65
11.	1938	Annual Report, Malaria Institute	Bazpur, Nainital, Uttar Pradesh	1817	2	0	2
12.	1939	Mathew	S. Travancore, Kerala	2602	616	339	955
13.	1939	Covell & Harbhagwan	Wynaad, Kerala	2781	445	213	658
14.	1939	Covell & Harbhagwan	Chedleth	374	22	11	33
15.	1940	Senior White & Narayana	Singhbhum hills, Bihar	81	1	1	2
16.	1940	Senior White & Adhikari	Satpura, Madhya Pradesh	931	41	26	67
17.	1941	Rao	Bihar Prov.	813	34	16	50
18.	1941	Senior White	Hazaribagh, Bihar	2167	46	31	77
19.	1941	Senior White	Madras Prov., Tamil Nadu (Trap collection)	218	8	1	9
20.	1941	Senior White	Madras Prov., Tamil Nadu (Resting collection)	1301	8	3	11
21.	1942	Russell & Rao	Coonoor, Tamil Nadu	2580	252	262	514
22.	1942	Russell & Jacob	Nilgiris Distt. Tamil Nadu	NM	9.7%	10.1%	—
23.	1943	Viswanathan & Ramachandra Rao	North Kanara, Karnataka	NM	29.6%	37.0%	—
24.	1943	Bombay Malaria Organization	Thane, Maharashtra	574	—	—	23

(Contd.)

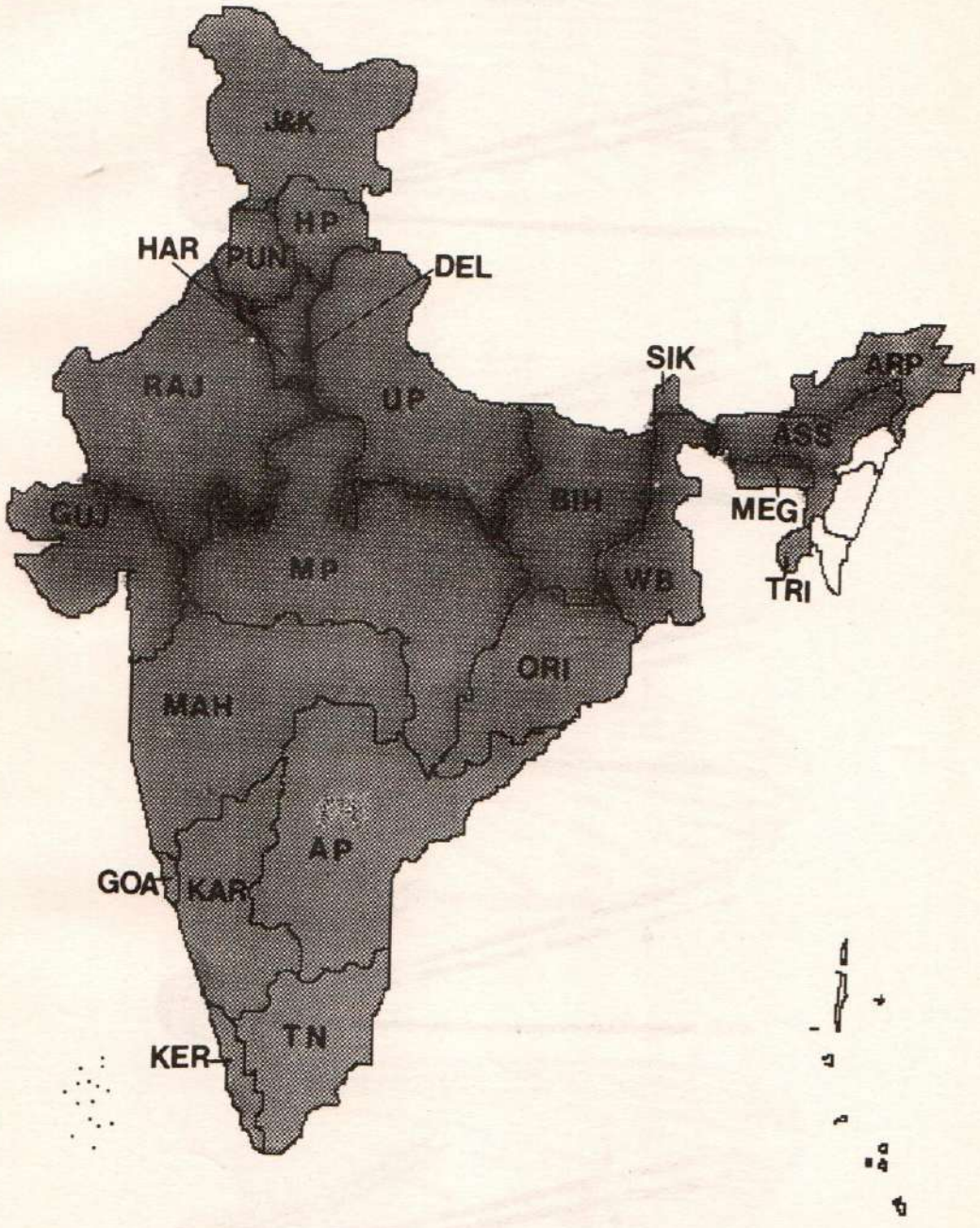
Table : *Anopheles fluviatilis*: Results of vector incrimination studies (Contd.)

Sl. No.	Year	Author	Locality	Number dissected	Number Positive		
					Gut	Gland	Total
25.	1944	Singh & Jacob	N. Kanara, Karnataka	897	48	64	112
26.	1944	Abraham & Samuels	Nizamabad, Andhra Pradesh	177	1	0	1
27.	1945	Viswanathan	Bombay Prov., Maharashtra	191	—	—	16
28.	1946	Senior White & Ghosh	West Bengal	2032	77	54	131
29.	1946c	Senior White	E. Cen. Prov., Madhya Pradesh	3552	101	72	173
30.	1946	Senior White & Ghosh	Jeypore hills, Orissa	NM	3.8%	2.6%	—
31.	1947	Senior White *et al.*	Delhi, Union Territory	767	67	33	100
32.	1948	Godbole *et al.*	Bombay Prov., Maharashtra	981	0	1	1
33.	1948	Subramanian & Dixit	Cent. Prov., Madhya Pradesh	1324	0	17	17
34.	1948	Ramakrishnan *et al.*	South Kanara, Karnataka	NM	—	8.7%	—
35.	1948–49	Bombay Malaria Organization	Panchmahal, Gujarat	124	0	1	1
36.	1950	Subramanian & Gupta	Cent. Prov., Madhya Pradesh	1335	0	9	9
37.	1950	Viswanathan	Bijapur, Maharashtra	980	—	—	1
38.	1950	Viswanathan	Kolaba, Maharashtra	NM	0.44%	—	—
39.	1950	Viswanathan	Nasik, Maharashtra	1475	—	—	3
40.	1950	Viswanathan	Poona, Maharashtra	6202	—	—	5
41.	1952	Srivastava & Chakrabarti	Terai, Nainital, Uttar Pradesh	NM	—	11.1%	—
42.	1952	Srivastava & Chakrabarti	Terai, Nainital, Uttar Pradesh	NM	—	1.6%	—
43.	1953	Issaris *et al.*	Terai, Nainital, Uttar Pradesh	7806	0	7	7
44.	1957	Bhatia *et al.*	Udaipur, Rajasthan	48	0	1	1
45.	1980	Annual Report, NICD	Jagdalpur, Madhya Pradesh	19571	1	1	2
46.	1983	Choudhury *et al.*	Gadarpur, Nainital, Uttar Pradesh	579	0	2	2
47.	1984	Annual Report, NMEP	Nagaland	44	1	0	1
48.	1984–85	Annual Report, MRC	Nainital, Uttar Pradesh	450	0	1	1
49.	1986	NMEP, Review Meeting Report	Mayurbhanj, Orissa	81	0	3	3
50.	1989	Gunasekaran *et al.*	Koraput, Orissa	653	3	6	9
51.	1990	S & T Project Report	Sonapur, Assam	205	0	4	4
52.	1990	Kulkarni	Bastar, Madhya Pradesh	NM	2.08%	1.2%	—

NM—Not Mentioned



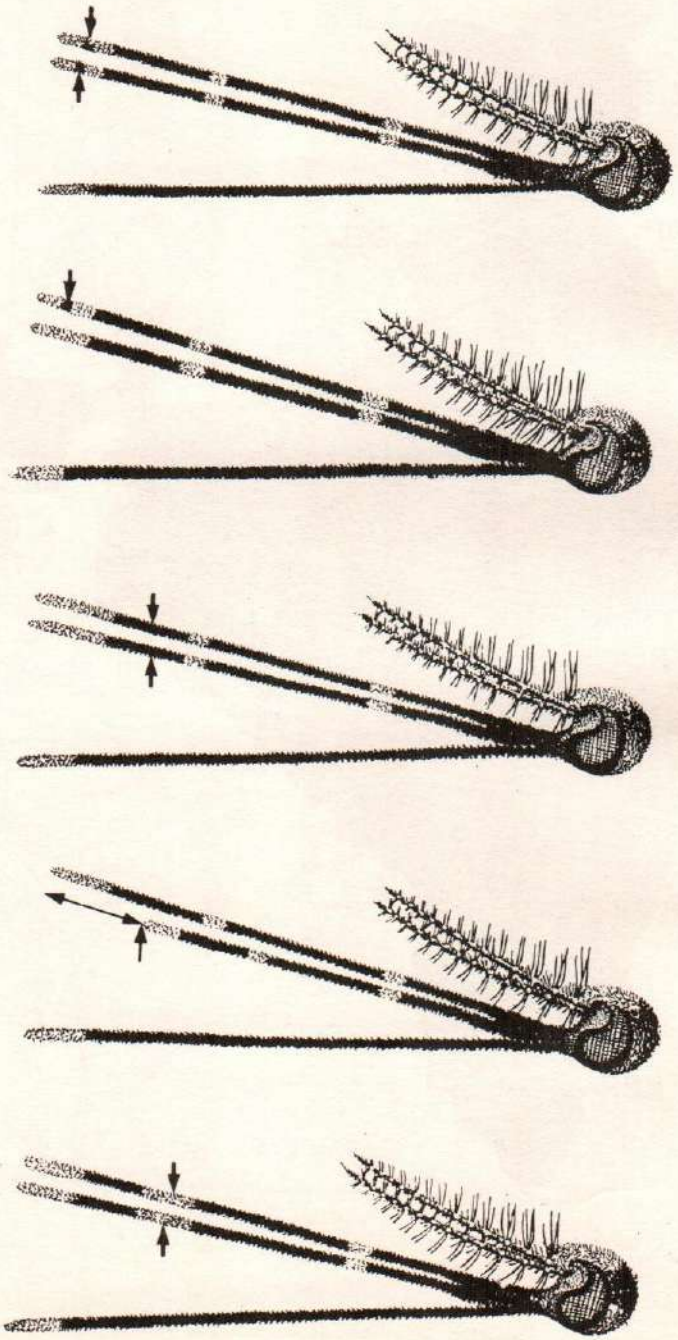
Reported distribution of *An. fluviatilis* in the World.



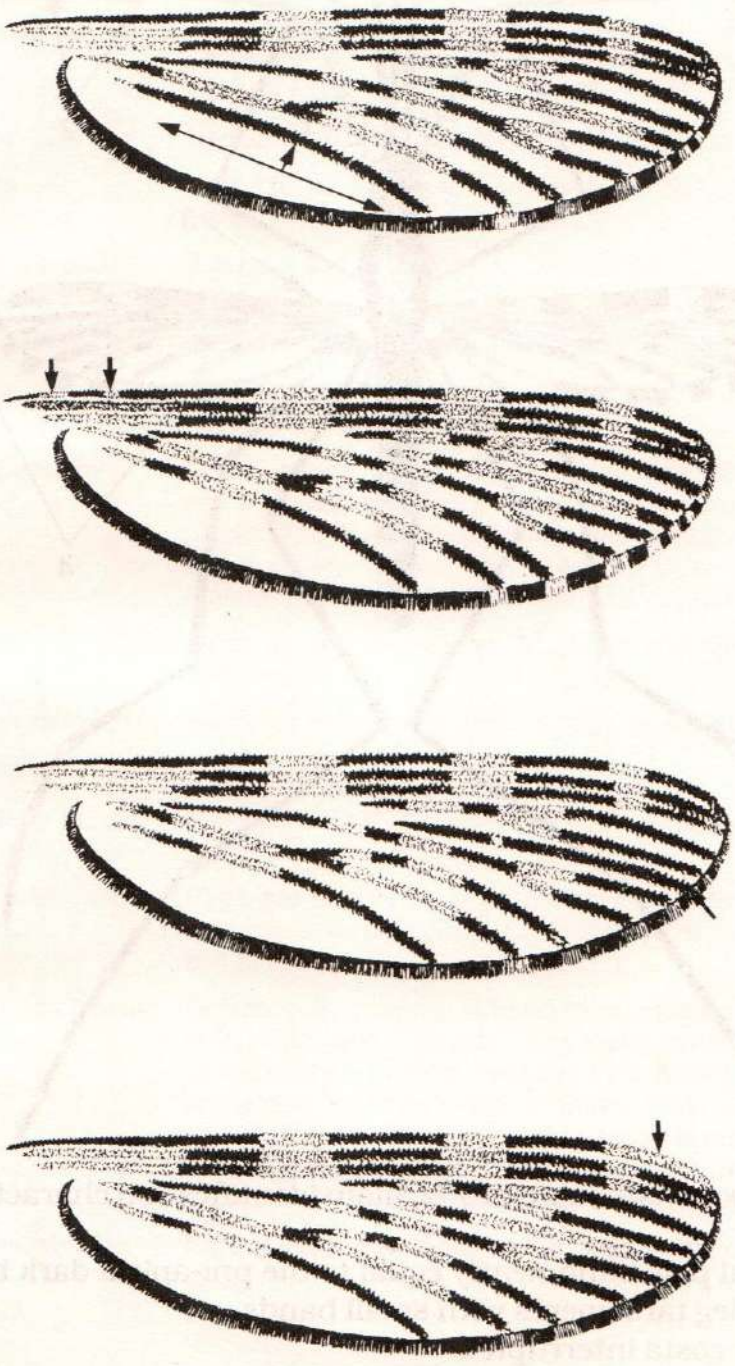
Reported distribution of *An. fluviatilis* In India.

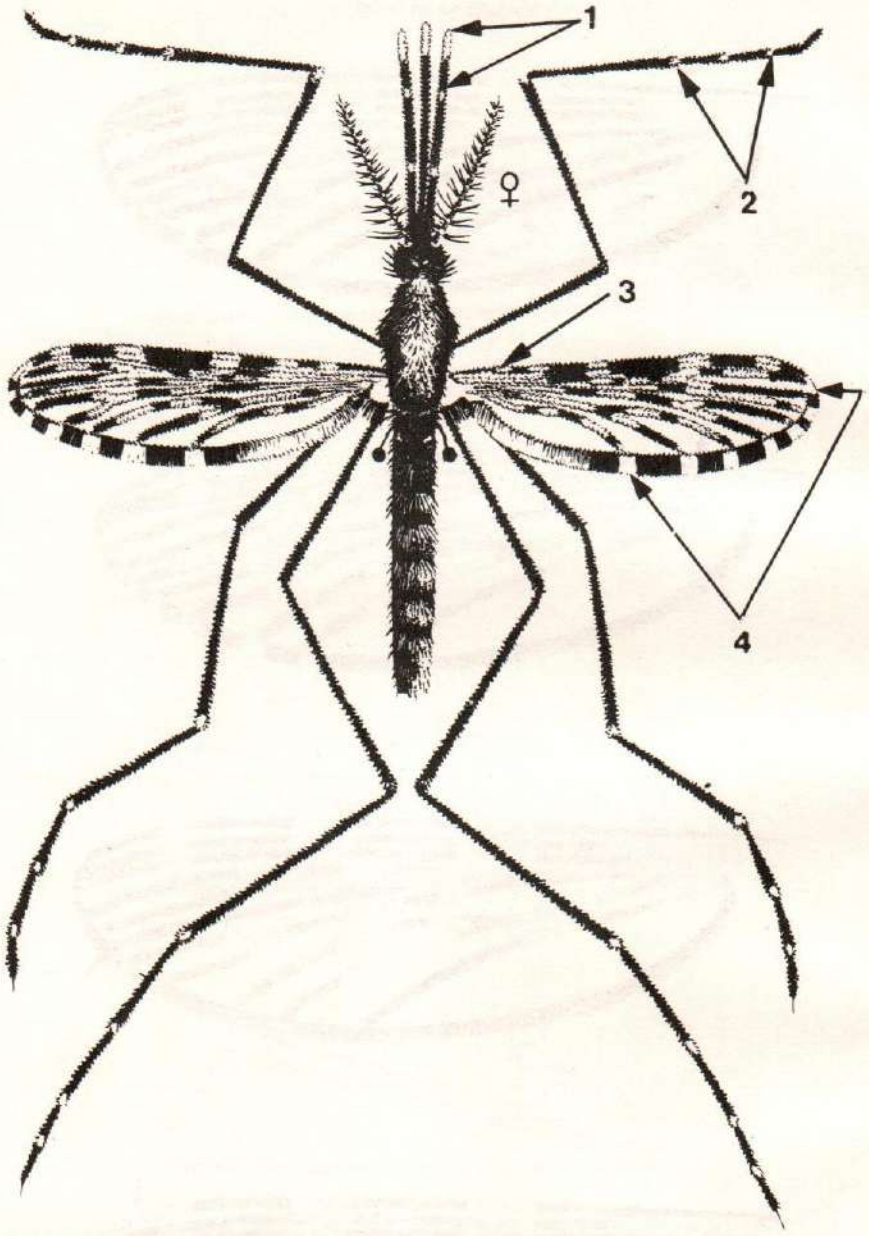
REPORTED IMPORTANT VARIATIONS OF *An. fluviatilis*

Variations in palpi



Variations in wing





An. jeyporiensis James 1902, main identification characters

1. Apical pale band nearly equal to the pre-apical dark band.
2. Fore leg tarsomeres with small bands.
3. Inner costa interrupted.
4. Fringe spot on all the veins.

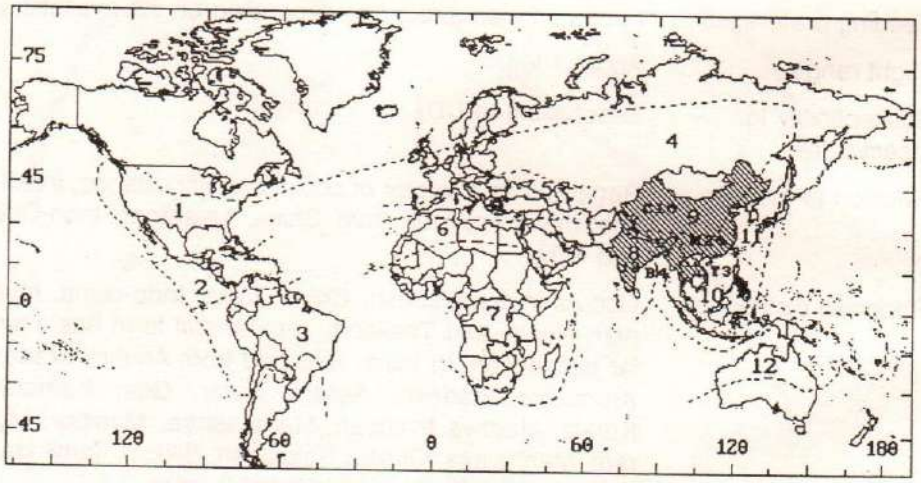
Anopheles jeyporiensis

Name	:	*An. jeyporiensis* James, 1902. *Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Govt. of India* (New Series), **2**: 106.
Derivative	:	Named by James after Jeypore hills in Orissa India.
Type form	:	Available at the British Museum of Natural History, London.
Reported morphological variations	:	3 in palpi and 7 in wing
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Species found largely in cattlesheds but also inside houses. Found at altitudes from 2000 to 6000 m.
Breeding ecology	:	Grassy edges of slow running streams and channels as well as grassy edges of shallow tanks are ideal breeding places. The species also breeds in seepages, ricefields and a variety of breeding places with clear water, with preference for channels with marginal vegetation.
Biting time	:	Biting activity starts after 20.00 hrs and continues till midnight.
Feeding preference	:	Feeds on man and cattle depending on the availability.
Flight range	:	About 1 km.
Susceptibility to insecticides	:	Susceptible to DDT.
Relation to disease	:	Regarded as a vector of secondary importance; infected specimens reported from China, Myanmar, Indo-China and India.
Reported distribution	:	Occurs in Bangladesh, China, India, Indo-china, Myanmar, Nepal, and Thailand. The varietal form has a similar distribution. In India, recorded from Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Goa, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Mizoram, Meghalaya, Orissa, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, and West Bengal.
Vector incrimination	:	Results of studies made so far are summarized in the table.

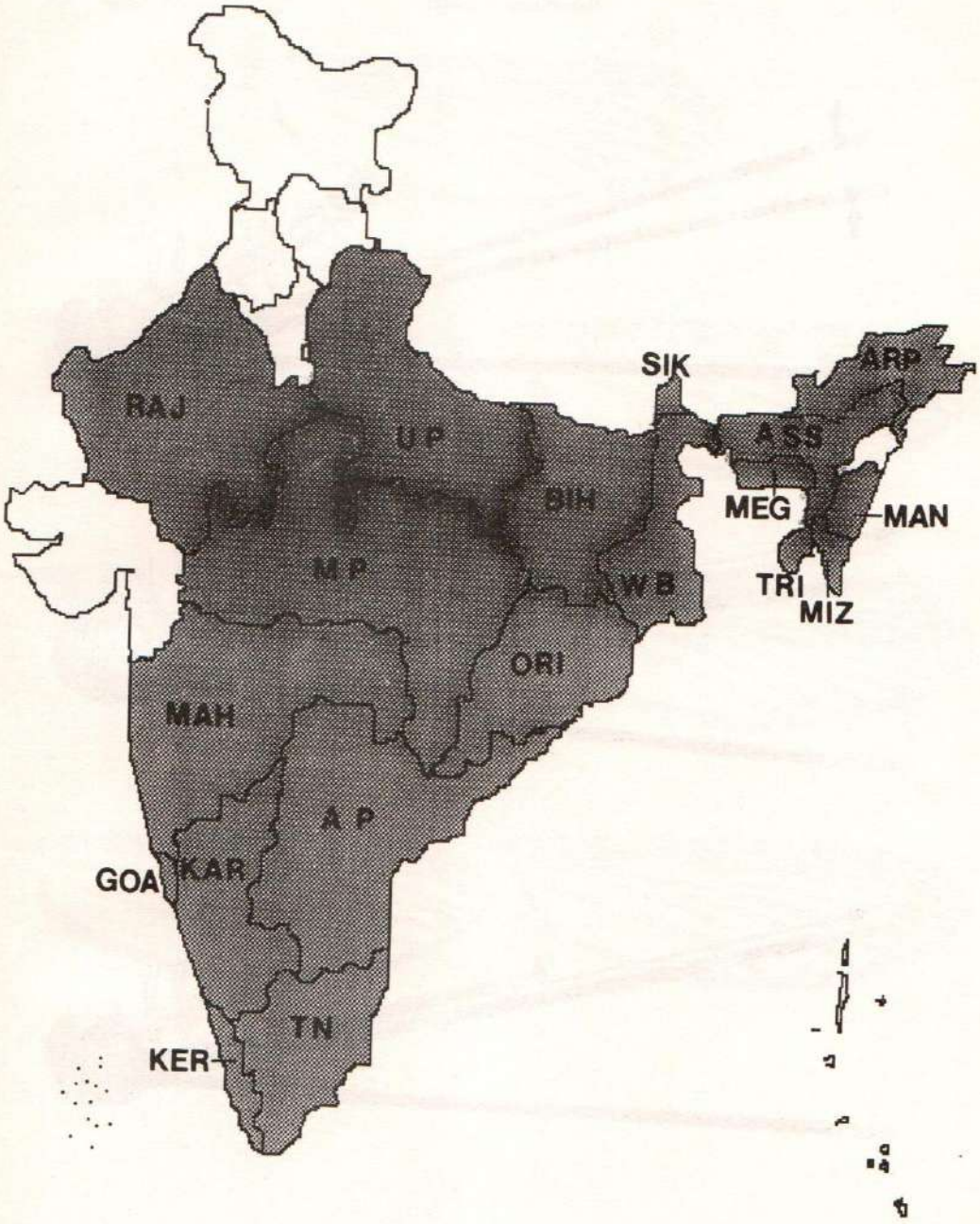
Table : *Anopheles jeyporiensis*: Results of vector incrimination studies

Sl. No.	Year	Author	Locality	Number dissected	Number Positive		
					Gut	Gland	Total
1.	1934	Covell	Mysore, Karnataka	674	2	0	2
2.	1934	Iyengar	Kulasekharam, Travancore, Kerala	3833	3	0	3
3.	1934	Nursing *et al.*	Mysore, Karnataka	1338	2	0	2
4.	1936	Ramsay *et al.*	Assam	2000	1	0	1
5.	1937c	Senior White	Jeypore hills, Orissa	318	4	0	4
6.	1944	Covell	Assam	2000	1	0	1
7.	1944	Covell	West Bengal	3833*	4	0	4
8.	1944	Covell	Jeypore hills, Orissa	318	4	0	4
9.	1945	Senior White *et al.*	Delhi, Union Territory	135*	4	0	4
10.	1945	Senior White *et al.*	Jeypore hills, Orissa	135	4	0	4
11.	1945	Senior White	Jeypore hills, Orissa	248	1	0	1

* Variety *candidiensis*



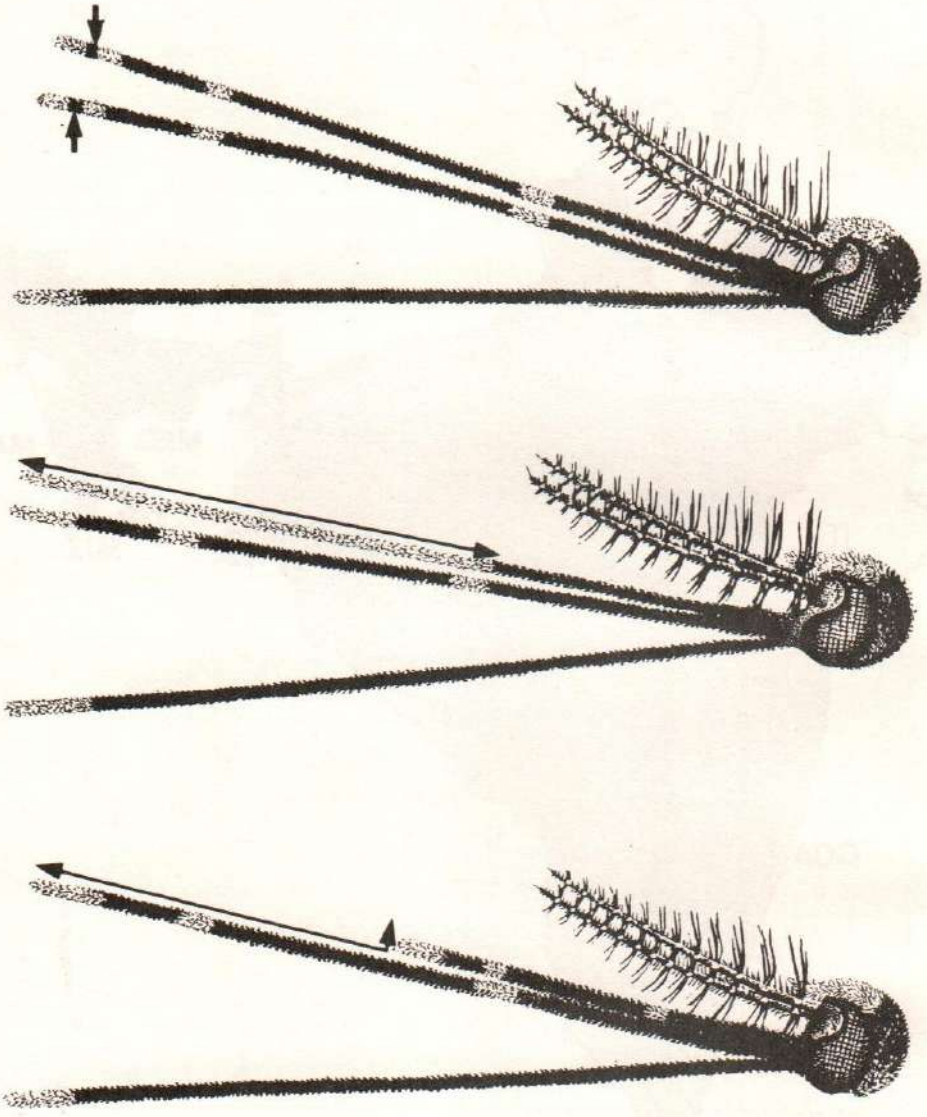
Reported distribution of *An. jeyporiensis* in the World.



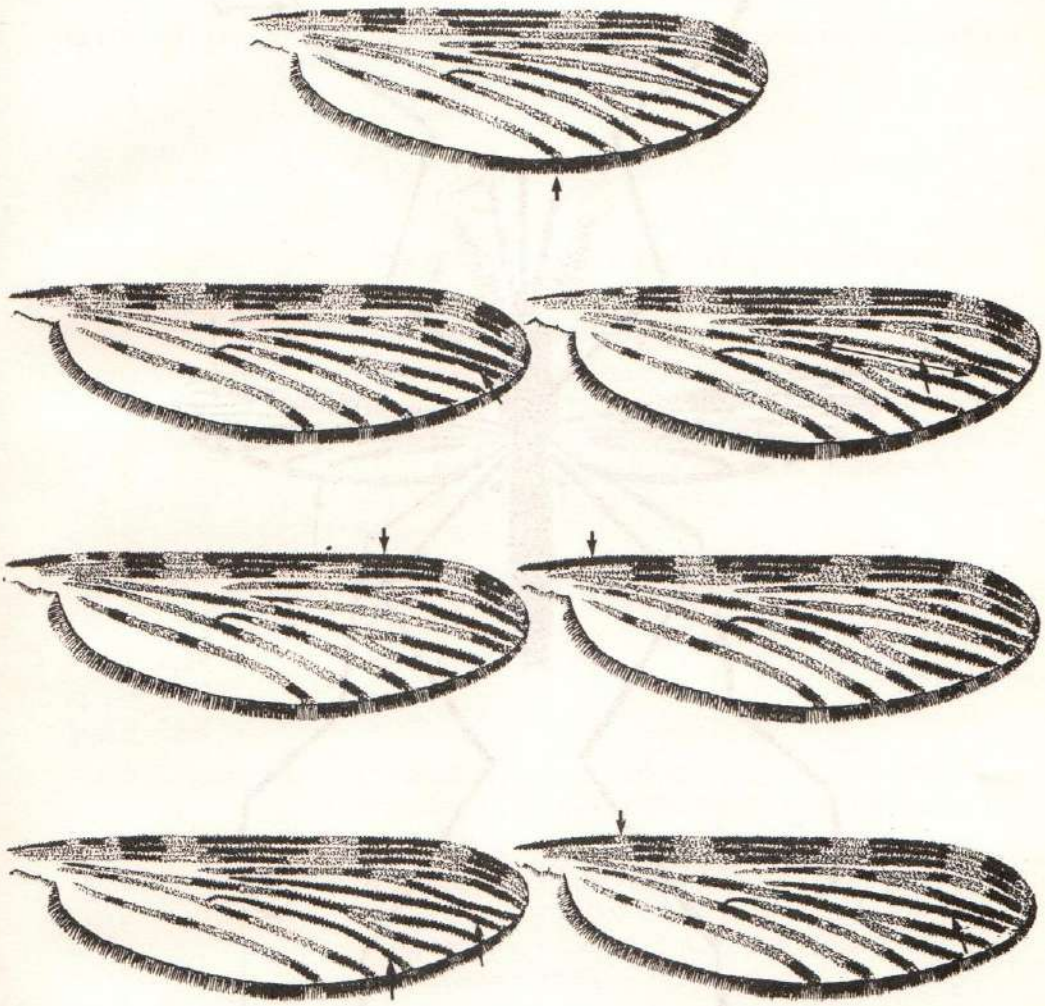
Reported distribution of *An. jeyporiensis* in India.

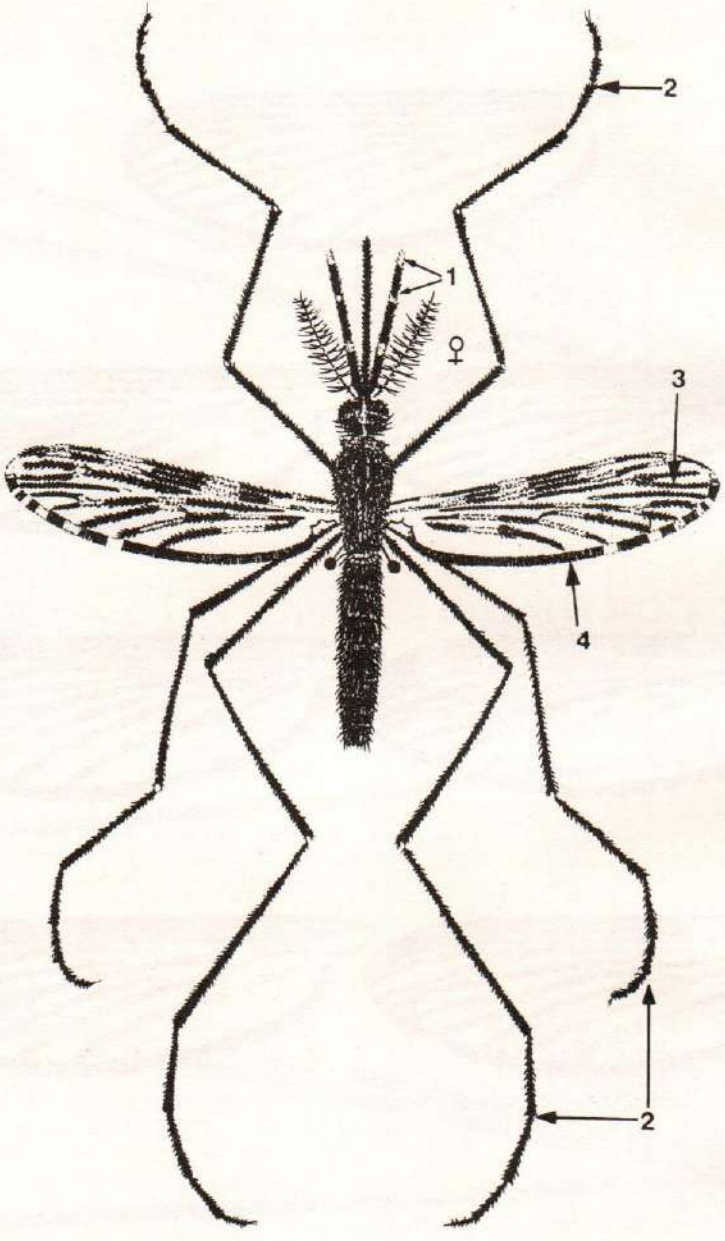
REPORTED IMPORTANT VARIATIONS OF *An. jeyporiensis*

Variations in palpi



Variations in wing



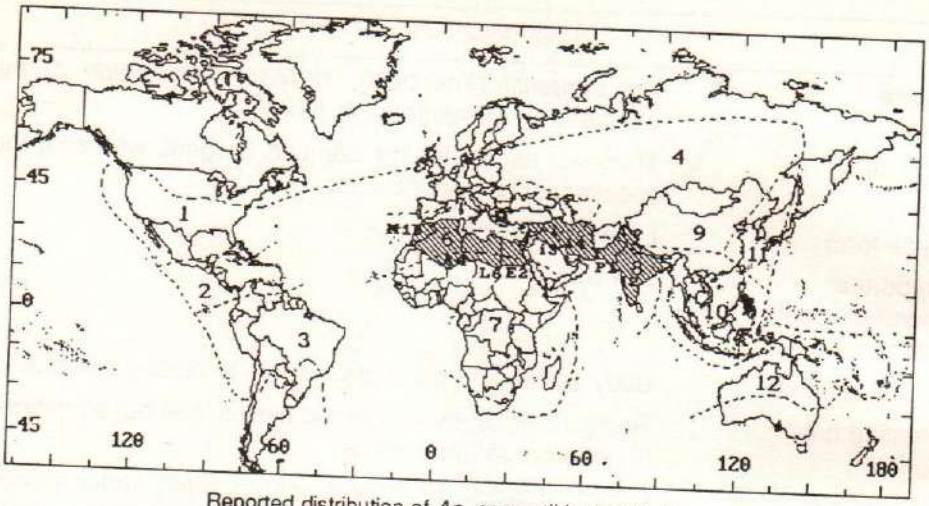


An. sergentii (Theobald) 1907, main identification characters

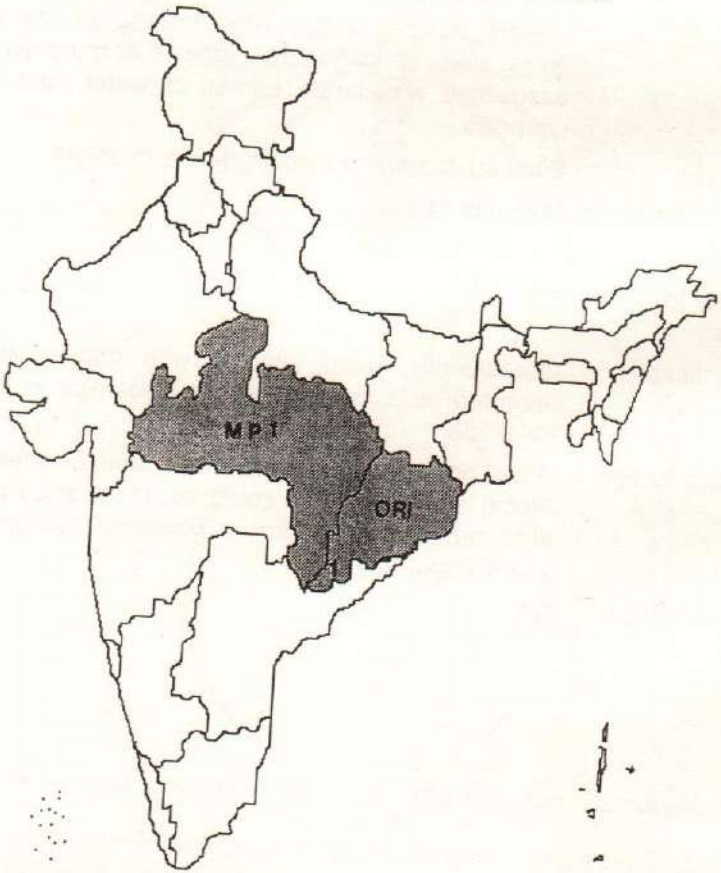
1. Apical pale band nearly equal to the pre-apical dark band.
2. Tarsomeres without bands.
3. Vein 3 (R4+5) mainly dark.
4. Fringe spot absent on vein 6 (Anal vein).

Anopheles sergentii

Name	:	*An. sergentii* (Theobald), 1907. *A Monograph of the Culicidae or Mosquitoes*, **4**: 68–69.
Derivative	:	Theobald named it after Edmond Sergent, who sent the specimens for identification.
Type form	:	Location not known.
Reported morphological variations	:	2 in wing
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Rests in human dwellings and cattlesheds but sometimes in underground aqueducts.
Breeding ecology	:	Breeds in small pools and springs often under stones. Sometimes breeds in ricefields and stagnant water. Prefers flowing water. Also breeds at the edge of lakes, small seepages from springs or marshes or pools associated with larger bodies of water, and seepage channels.
Biting time	:	Bites outdoors and indoors before midnight.
Feeding preference	:	Man and cattle.
Flight range	:	About 4 km.
Susceptibility to insecticides	:	NA
Relation to disease	:	Occasionally found infected with human *Plasmodia*, regarded as a cause of some epidemics in Egypt and Palestine.
Reported distribution	:	Wide occurrence in the entire Mediterranean (North Africa) and West Asian countries, India, and Pakistan. In India, recently recorded from Jabalpur (Madhya Pradesh) and Koraput (Orissa).
Vector incrimination	:	NA



Reported distribution of *An. sargentii* in the World.



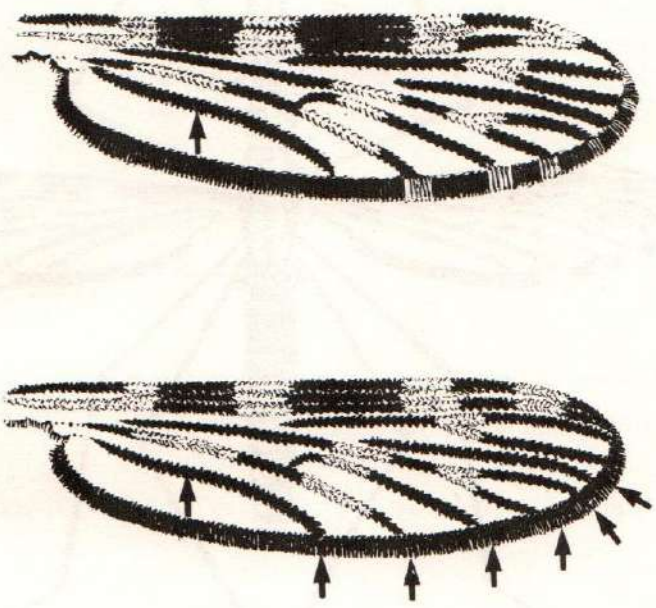
MADHYA PRADESH (MP)
1. Jabalpur

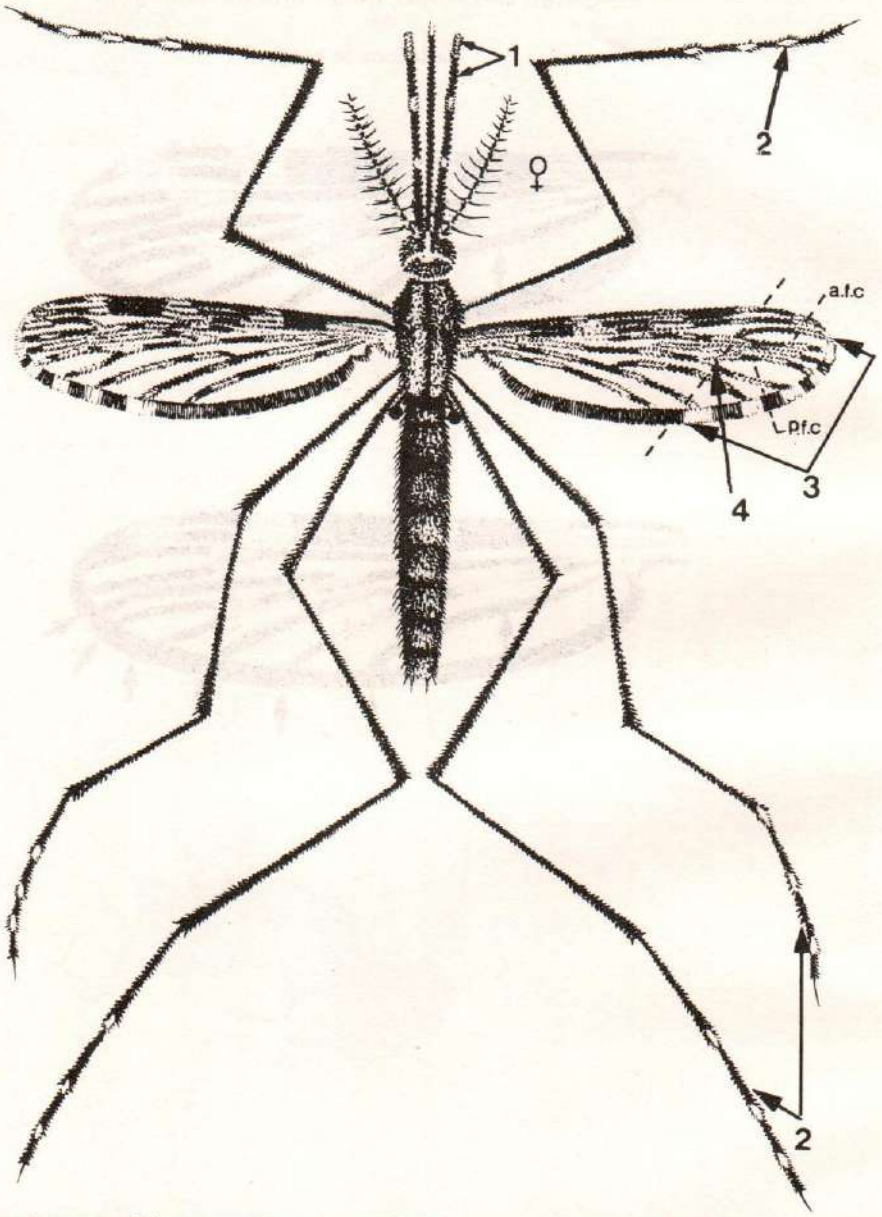
ORISSA (ORI)
1. Koraput

Reported distribution of *An. sergentii* in India.

REPORTED IMPORTANT VARIATIONS OF *An. sergentii*

Variations in wing



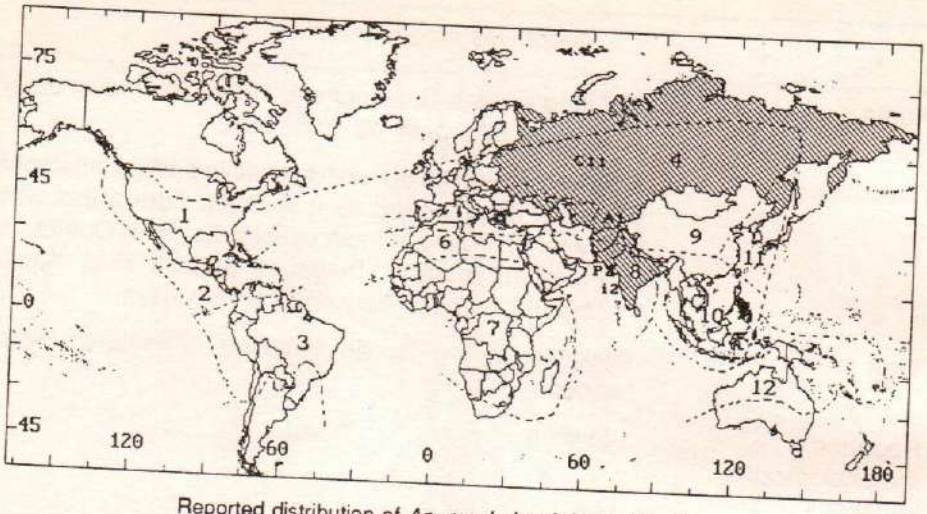


An. moghulensis Christophers 1924, main identification characters

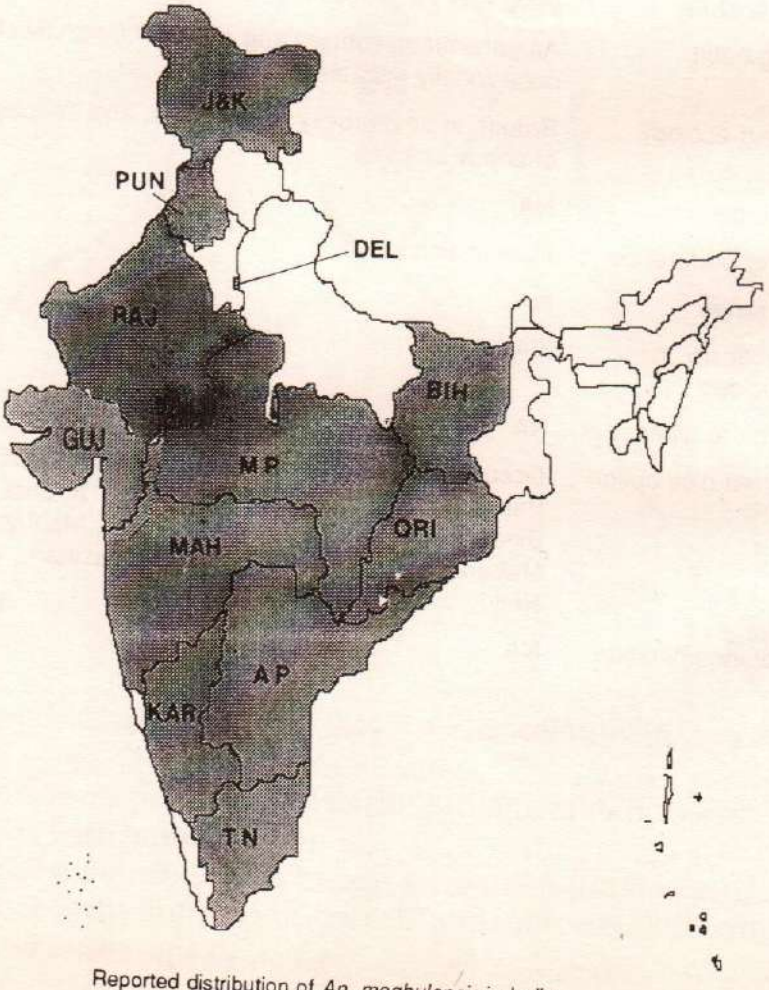
1. Apical pale band nearly equal to the pre-apical dark band
2. Tarsomeres with bands
3. Fringe spot on all the veins except on vein 6 (Anal vein)
4. The distance of the anterior forked cell from the base of the wing is more than posterior forked cell

Anopheles moghulensis

Name	:	*An. moghulensis* Christophers, 1924. *The Indian Journal of Medical Research.* **12**: 295–301.
Derivative	:	Moghul Empire; Latin, *-ensis*, locative suffix. Christophers named it *moghulensis* as it is found from areas where the Moghul empire in India existed, i.e. from Quetta (now in Pakistan) Bombay, Belgaum, Satpura Hills, Kasauli, Pachmarhi hills and from Central Provinces.
Type form	:	Available at the British Museum of Natural History, London.
Reported morphological variations	:	1 in wing
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	An uncommon species and rests in human dwellings and occasionally in cattlesheds.
Breeding ecology	:	Breeds in small rocky hill streams, and seepage waters of shady streams.
Biting time	:	NA
Feeding preference	:	Human and cattle.
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	NA
Reported distribution	:	Occurs in Afghanistan, India, Kazakh (USSR), and Pakistan. In India, recorded from Andhra Pradesh, Bihar, Karnataka, Jammu & Kashmir, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, and Tamil Nadu.
Vector incrimination	:	NA



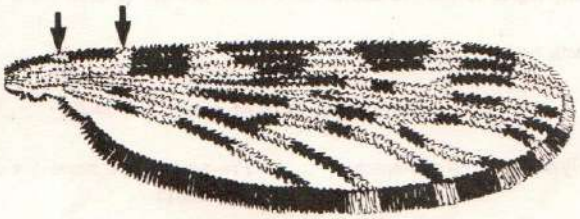
Reported distribution of *An. moghulensis* in the World.



Reported distribution of *An. moghulensis* in India.

REPORTED IMPORTANT VARIATIONS OF *An. moghulensis*

Variation in wing



1.4. An. subpictus, An. sundaicus, An. vagus

Wing with 4 or more pale areas on the costa, subcosta including vein 1(R1)

Apical pale band nearly equal to the pre-apical dark band; pre-apical dark band 1/4 or 1/5 of apical pale band

Foreleg tarsomeres with broad pale bands

Banding pattern of palpi

Apical pale band nearly equal to the pre-apical dark band

An. subpictus, An. sundaicus

Pre-apical dark band 1/4 or 1/5 of the apical pale band

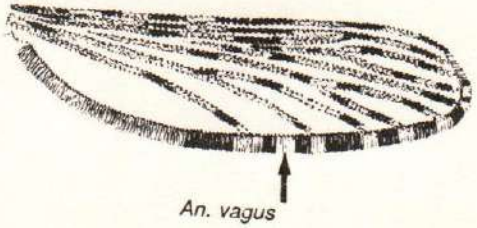
An. vagus

Other characters

Tarsomeres of foreleg with pale bands.

Legs without speckling

Fringe spot between veins 5(Cu) and 6(Anal) usually present



An. vagus

An. subpictus, An. sundaicus

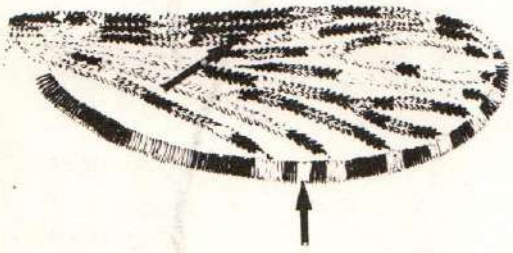
Speckling in legs

An. subpictus

An. sundaicus

Other characters

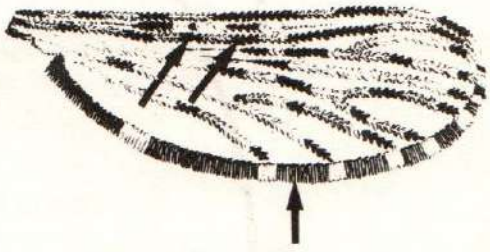
Main costal spot with one dark spot on vein 1(R1). Fringe spot between veins 5(Cu) and 6(Anal) usually present



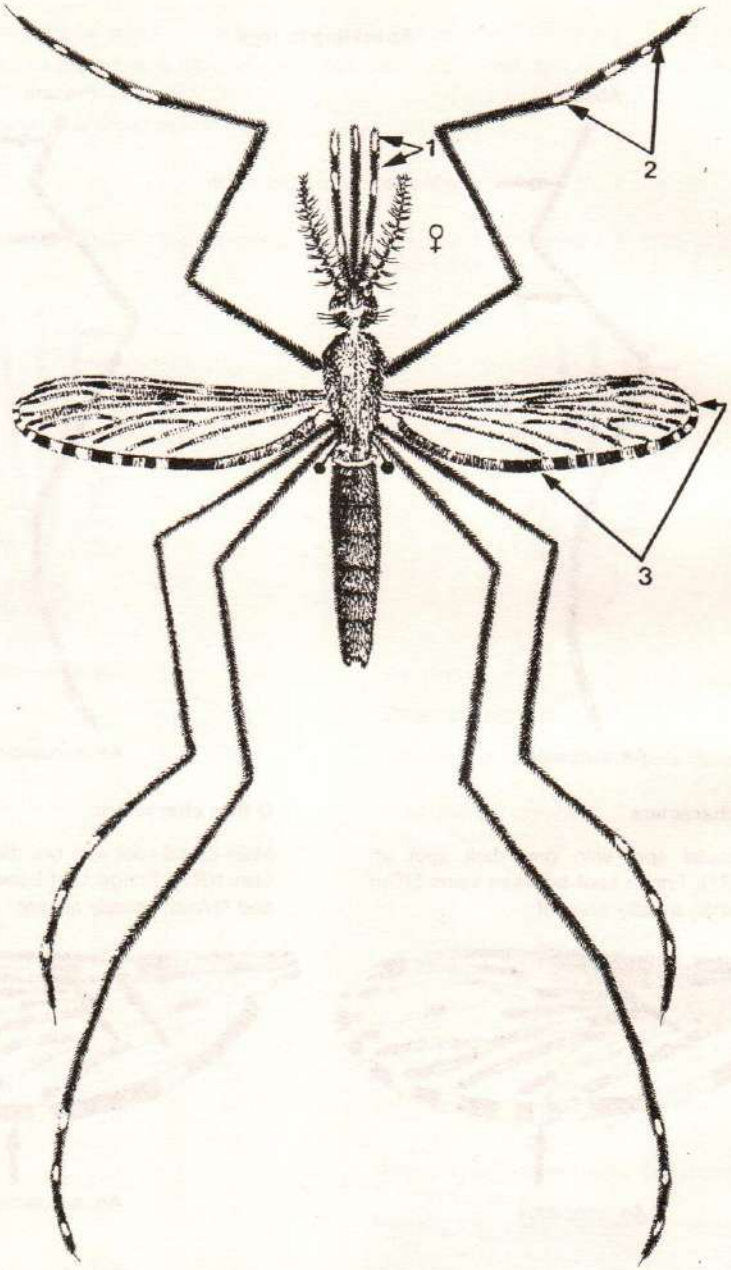
An. subpictus

O ther characters

Main costal spot with two dark spot areas on vein 1(R1). Fringe spot between veins 5(Cu) and 6(Anal) usually absent



An. sundaicus



An. subpictus Grassi 1899, main identification characters

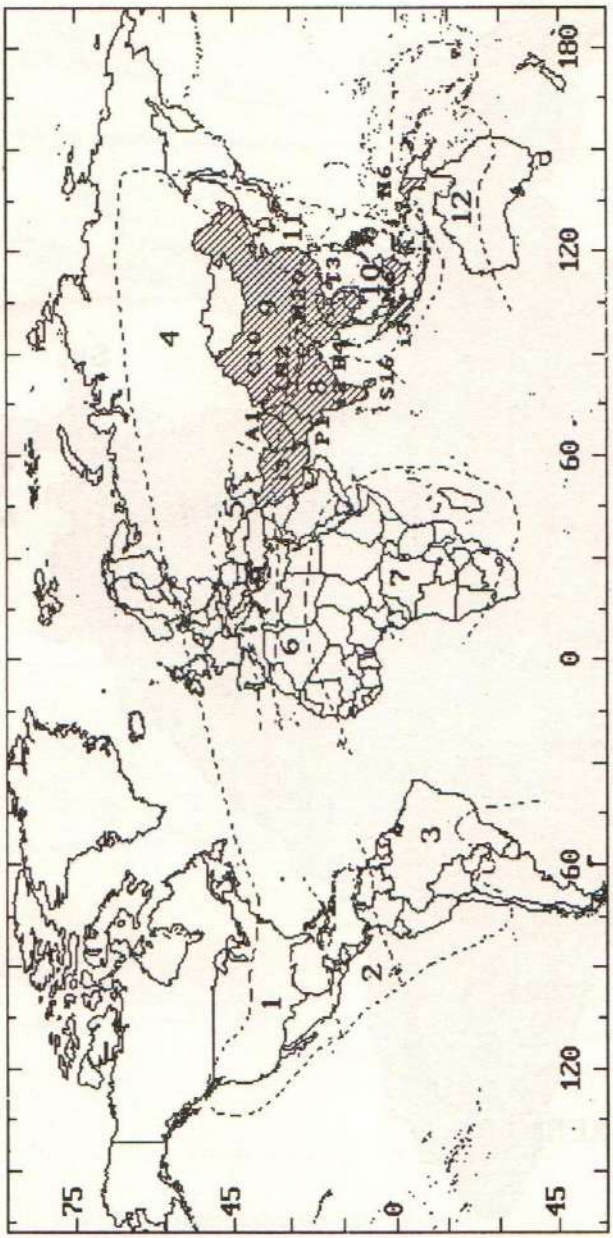
1. Apical pale band nearly equal to the pre-apical dark band
2. Fore leg tarsomeres with broad bands
3. Fringe spot on all the veins

Anopheles subpictus

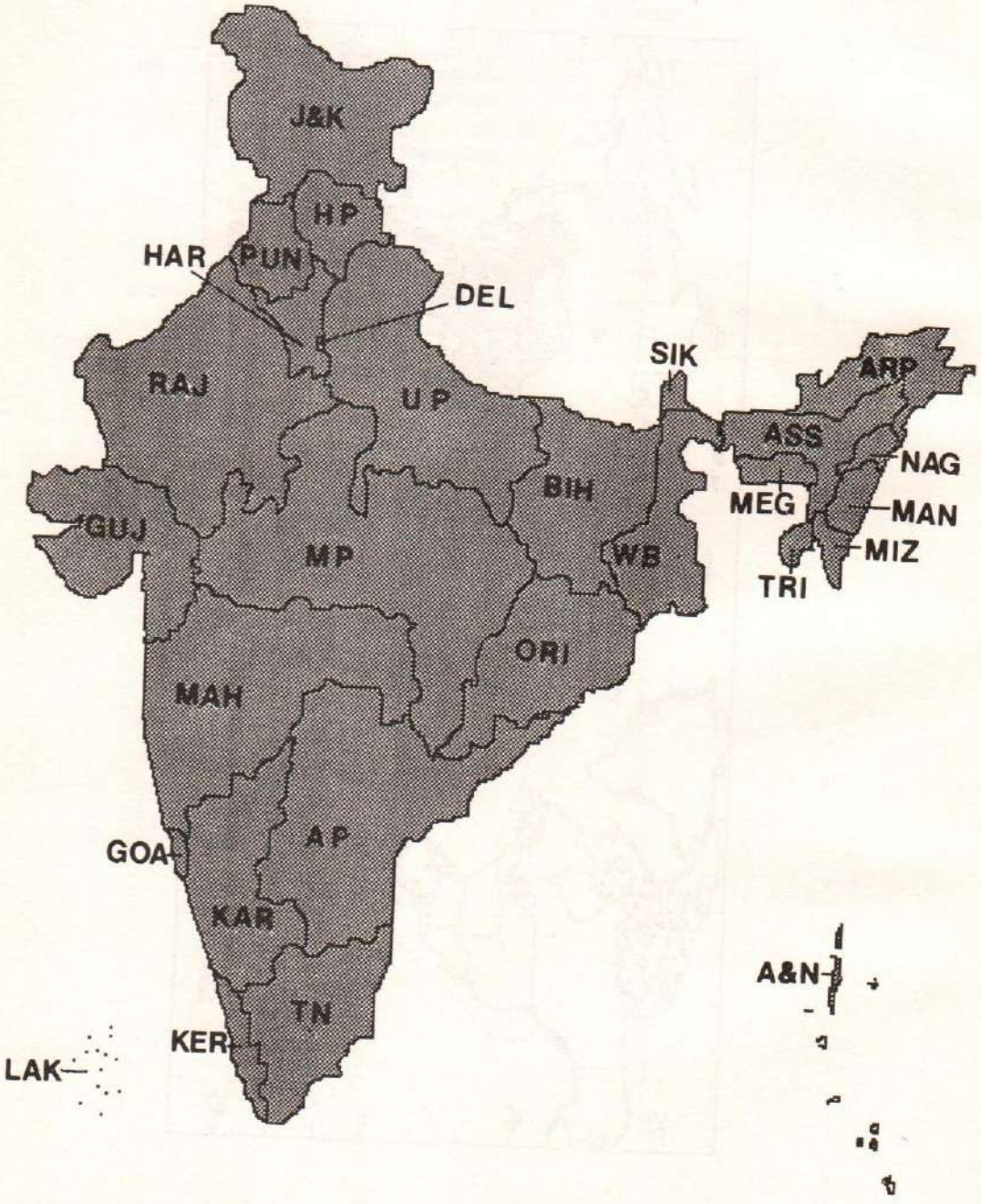
Name	:	*An. subpictus* Grassi, 1899. In: Grassi, Bignami and Bastianelli, 1899. Atti dell, Accademia Nazionale dei Lincei. *Rendiconti*, **8:** 100–104.
Old name	:	*An. rossii* Giles.
Derivative	:	In this case *sub* is used in one of its literal meanings, i.e. less than or smaller than. Grassi refers to it as "Forma piccola dell' India", comparing it with *pictus* as *pseudopictus* which he called the second small form of Italy.
Type form	:	Available at the Rome University Museum, Rome.
Reported morphological variations	:	11 in maxillary palpi and 1 in wing.
Species complex	:	Two sibling species.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Very commonly found in houses and cattlesheds. Often collected outdoors.
Breeding ecology	:	Breeds in a variety of habitats except the highly polluted or contaminated ones. In flowing or stagnant waters, clear or turbid waters, water with or without vegetation, unshaded or slightly shaded places, wells, borrowpits, channels, lake margins, ponds, tanks, ground pools, fallow and freshly flooded ricefields, cement cisterns, tree holes, fresh or brackish waters.
Biting time	:	Bites throughout night but peak biting between 18.00 and 22.00 hrs.
Feeding preference	:	Feeds predominantly on cattle and other domestic animals (zoophilic). May feed on man in the absence of cattle.
Flight range	:	1.5–6 km.
Susceptibility to insecticides	:	Resistant to DDT in India.
Relation to disease	:	A non-vector species but recently infected specimens with *Plasmodium* parasite recorded from India, Indonesia and Java.
Reported distribution	:	Occurs very widely in oriental regions extending from Afghanistan, Mariana Islands in the east; from China in the north and Sri Lanka in south. In India, occurs in all the mainland zones. Also reported from Andaman Islands and Lakshadweep.
Vector incrimination	:	Results of studies made so far are summarized in the table.

Table : *Anopheles subpictus*: Results of vector incrimination studies

Sl. No.	Year	Author	Locality	Number dissected	Number Positive		
					Gut	Gland	Total
1.	1939	Russell & Jacob	Ennore-Nellore, Tamil Nadu	4897	2	1	3
2.	1939	Russell *et al.*	Ennore-Nellore Pattukkottai Tamil Nadu	8381	4	1	5
3.	1940	Russell & Rao	Madras, Tamil Nadu	13277	1	1	2
4.	1981	Panicker *et al.*	South East India	3752	45	2	47
5.	1983	Kulkarni	Bastar, Madhya Pradesh	12107	0	3	3



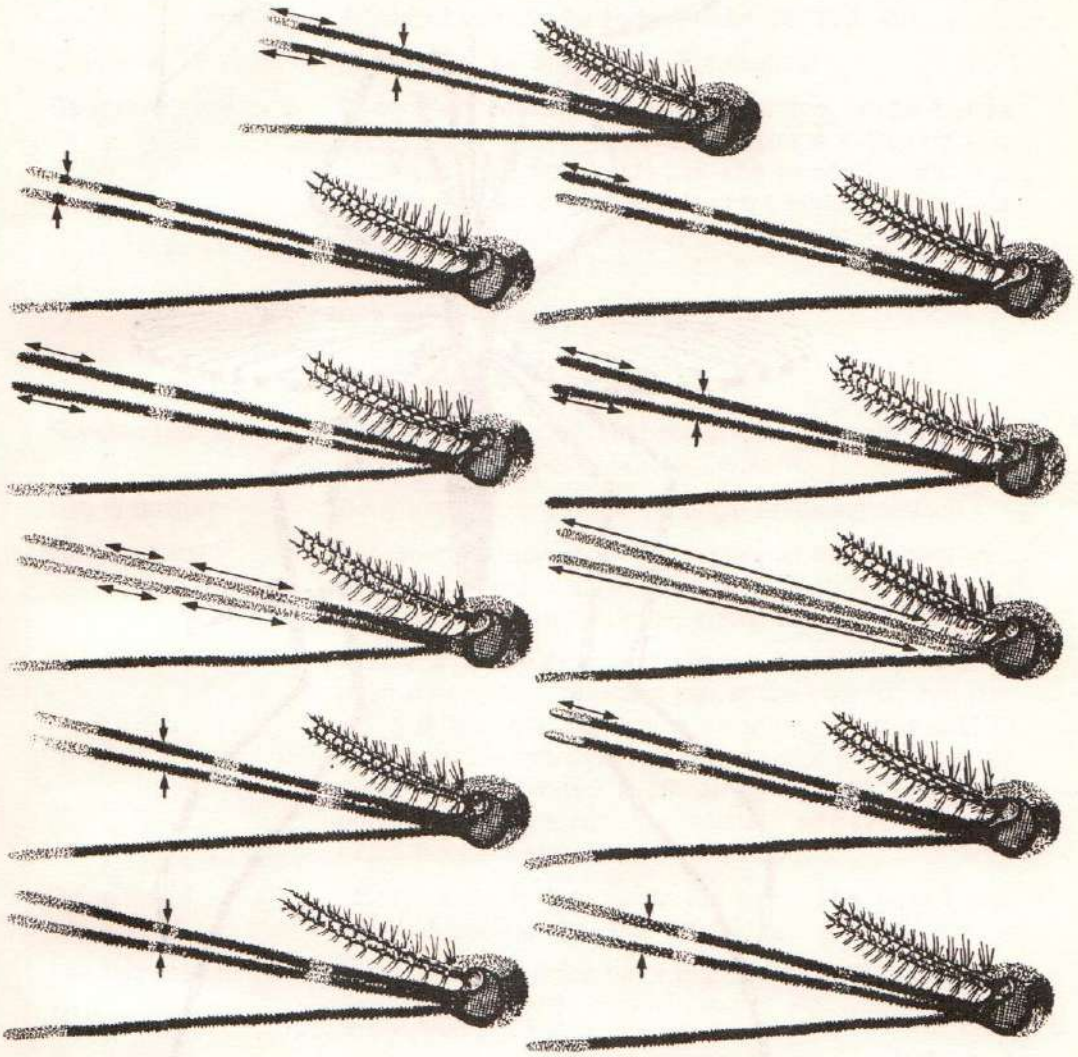
Reported distribution of *An. subpictus* in the World.



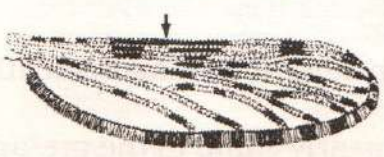
Reported distribution of *An. subpictus* in India.

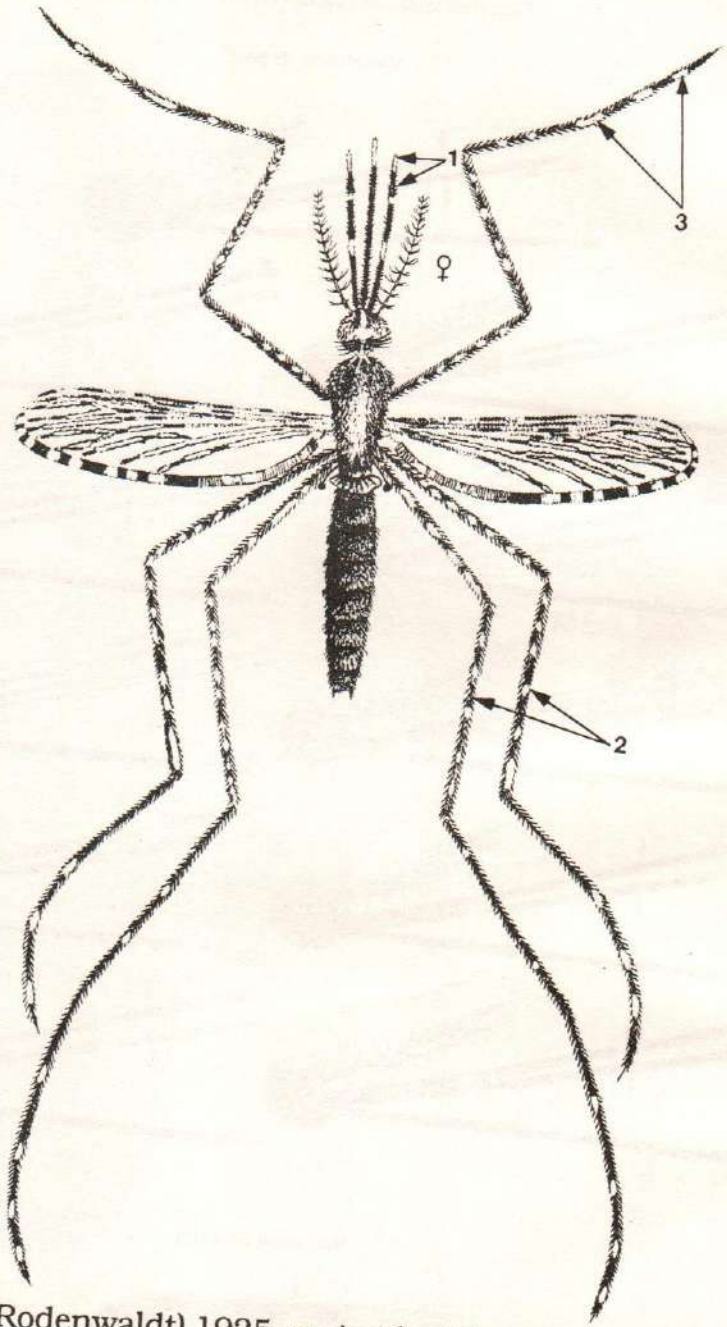
Reported important variations of *An. subpictus*

Variations in palpi



Variation in wing





An. sundaicus (Rodenwaldt) 1925, main identification characters

1. Apical pale band nearly equal to the pre-apical dark band
2. Legs with speckling
3. Fore leg tarsomeres with broad bands

Anopheles sundaicus

Name	:	*An. sundaicus* (Rodenwaldt), 1925. *Geneeskundig Tijdschrift voor Nederlandsch-Indie.* **65:** 173–201.
Old name	:	*An. ludlowi* var. *sundaicus*, Rodenwaldt
Derivative	:	Rodenwaldt collected the specimens from Lesser Sunda Islands, and also from Java, Sumatra and Borneo and named the species *sundaicus*. The Sunda Islands is a collective name for the Islands in the Malay Archipelago which extend from the Malay Peninsula to Timor, more or less identical with Indonesia.
Type form	:	Location not known.
Reported morphological variations	:	4 in maxillary palpi
Species complex	:	Two sibling species suspected. (One breeds in fresh water and the other in brackish water.)
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	The species rests indoors specially in human dwelling, cattlesheds and also outdoors, e.g. in rock crevices in sand banks, bushes in forest areas, etc.
Breeding ecology	:	Mainly a brackish water breeder but also breeds in fresh water. Major breeding places are swamps and pits along bunds, etc. containing stagnant, brackish water. Also breeds in salt-water lagoons, creeks, wells (brackish water or fresh water) overhead tanks, and freshwater pools in coastal areas. Can tolerate salinity from 0.08 to 2.6 per cent and pH from 7.7 to 8.5.
Biting time	:	Mostly outdoors throughout the night. The peak biting period is between 21.00 and 2.00 hrs.
Feeding preference	:	Indiscriminately on cattle or man. Highly anthropophilic.
Flight range	:	0.6–9 km.
Susceptibility to insecticides	:	Susceptible to DDT in India but resistant to DDT and dieldrin in Indonesia.
Relation to disease	:	An important vector of malaria throughout its range of occurrence in coastal areas but with some difference in the degree of transmission. Positive gut and gland specimens recorded from India, Java, Thailand, Malaysia and Indonesia.
Reported distribution	:	Occurs in Bangladesh, China, India, Indonesia, Myanmar, Sulawesi, and Sunda Island. In India, recorded earlier from Andhra Pradesh, Orissa, Tamil Nadu, and West Bengal; it is now restricted to only Andaman Islands

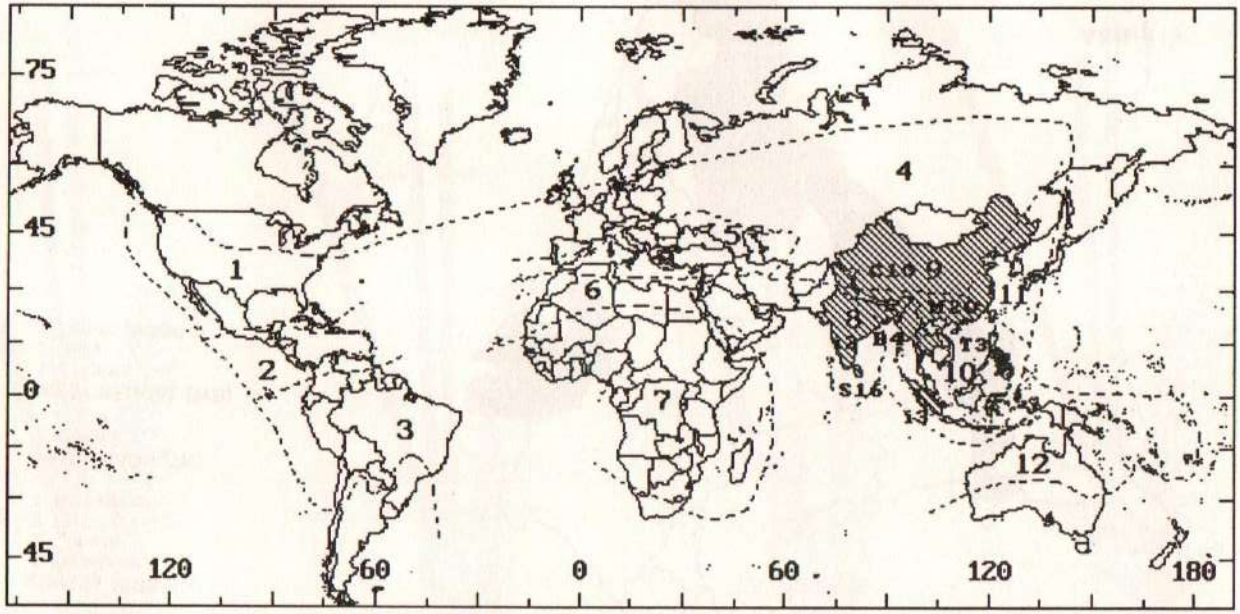
where it plays a major role in malaria transmission. Recently a focus on this species was also reported from the western region of the country, from Mandvi and Mundra coastal areas of Kutch district (Gujarat).

Vector incrimination : Results of studies made so far are summarized in the table.

Table : *Anopheles sundaicus:* Results of vector incrimination studies

Sl. No.	Year	Author	Locality	Number dissected	Number Positive		
					Gut	Gland	Total
1.	1912	Christophers	Andaman Island, Union Territory	53	2	0	2
2.	1914b	Hodgson	Madras, Tamil Nadu	NM	—	1	1
3.	1927	Covell	Andaman Island, Union Territory	98	1	1	2
4.	1931	Iyengar	Howrah, West Bengal	71	0	3	3
5.	1931	Iyengar	Industrial area, West Bengal	838	71	169	240
6.	1936	Ramsay & Macdonald	West Bengal	1593	0	175	175
7.	1938	Sen	West Bengal	124	2	2	4
8.	1939	Senior White & Adhikari	Chilka lake, Orissa	659	10	5	15
9.	1940	Iyengar	West Bengal	19	3	1	4
10.	1942	Panigrahi	Puri town, Orissa	617	5	7	12
11.	1942	Covell & Singh	Chilka lake, Orissa	10714	32	51	83
12.	1947	Senior White *et al.*	Chilka lake, Orissa	1059	13	12	25
13.	1947	Senior White *et al.*	N. Vizagapatnam, Andhra Pradesh	1280	60	33	93
14.	1948a	Sen	West Bengal	373	—	—	29

NM - Not mentioned



Reported distribution of *An. sundaicus* in the World.

ANDHRA PRADESH (AP)
1. Vishakhapatnam

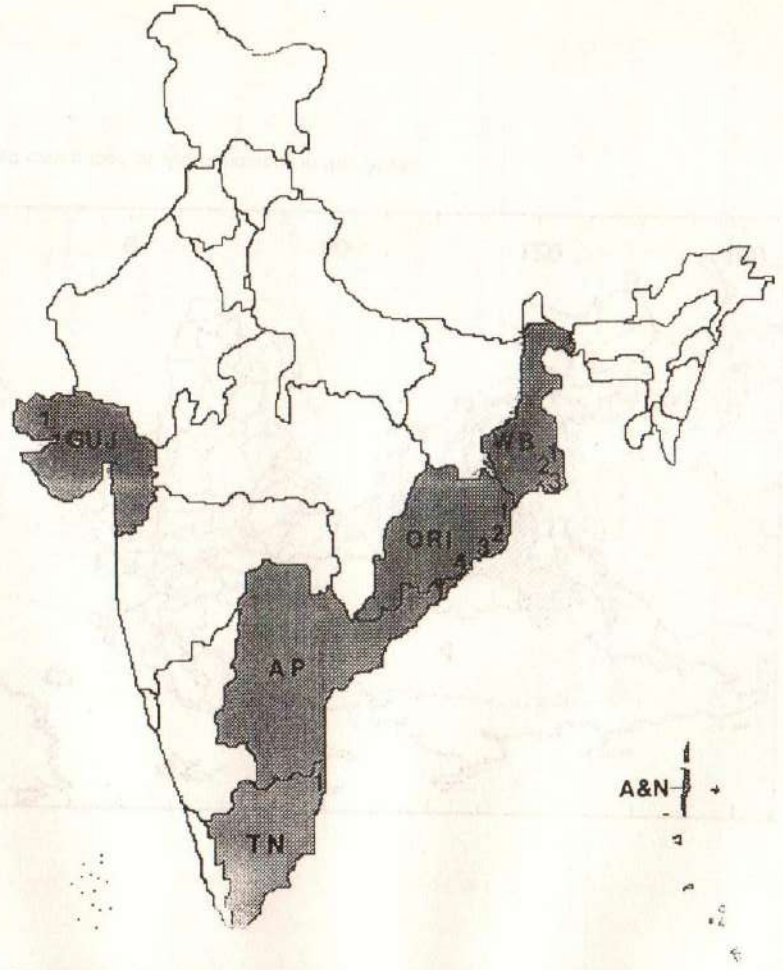
ANDAMAN & NICOBAR ISLANDS (A & N)
1. Andaman Islands

GUJARAT (GUJ)
1. Kutch (Mandvi and Mundra)

ORISSA (ORI)
1. Baleshwar
2. Cuttack
3. Puri
4. Berhampur

TAMIL NADU (TN)
1. Madras

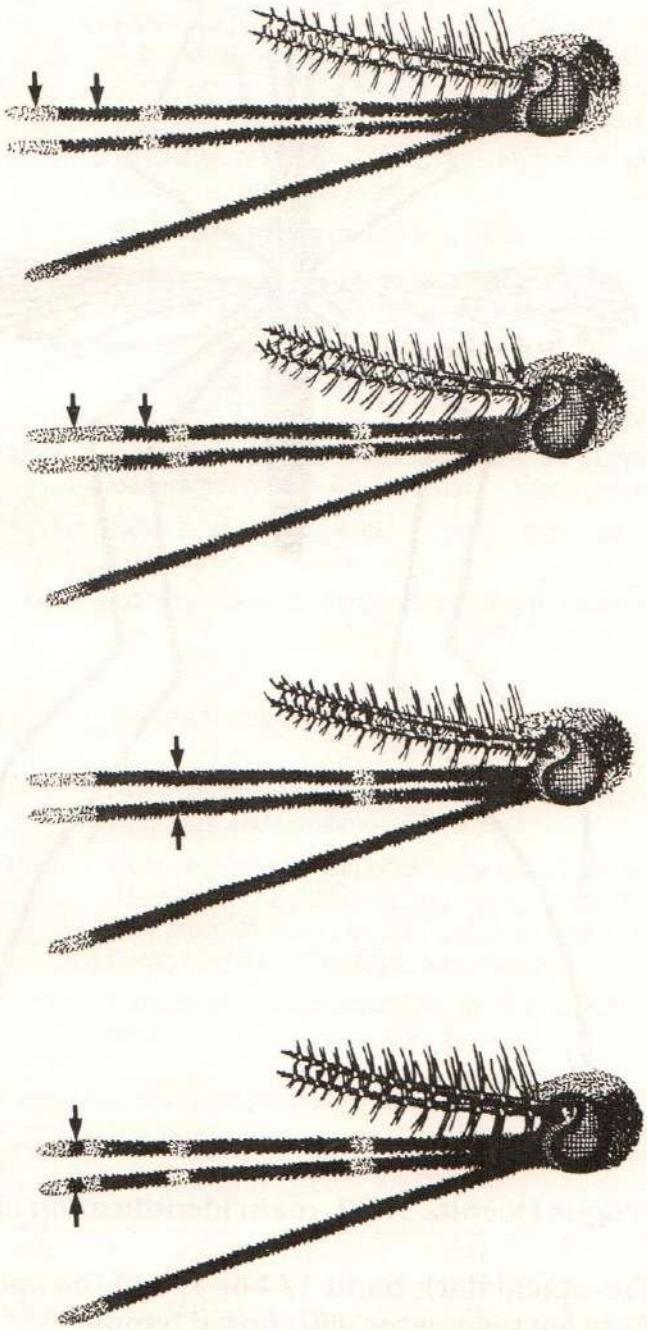
WEST BENGAL (WB)
1. Calcutta
2. Bally
3. Deltaic Bengal

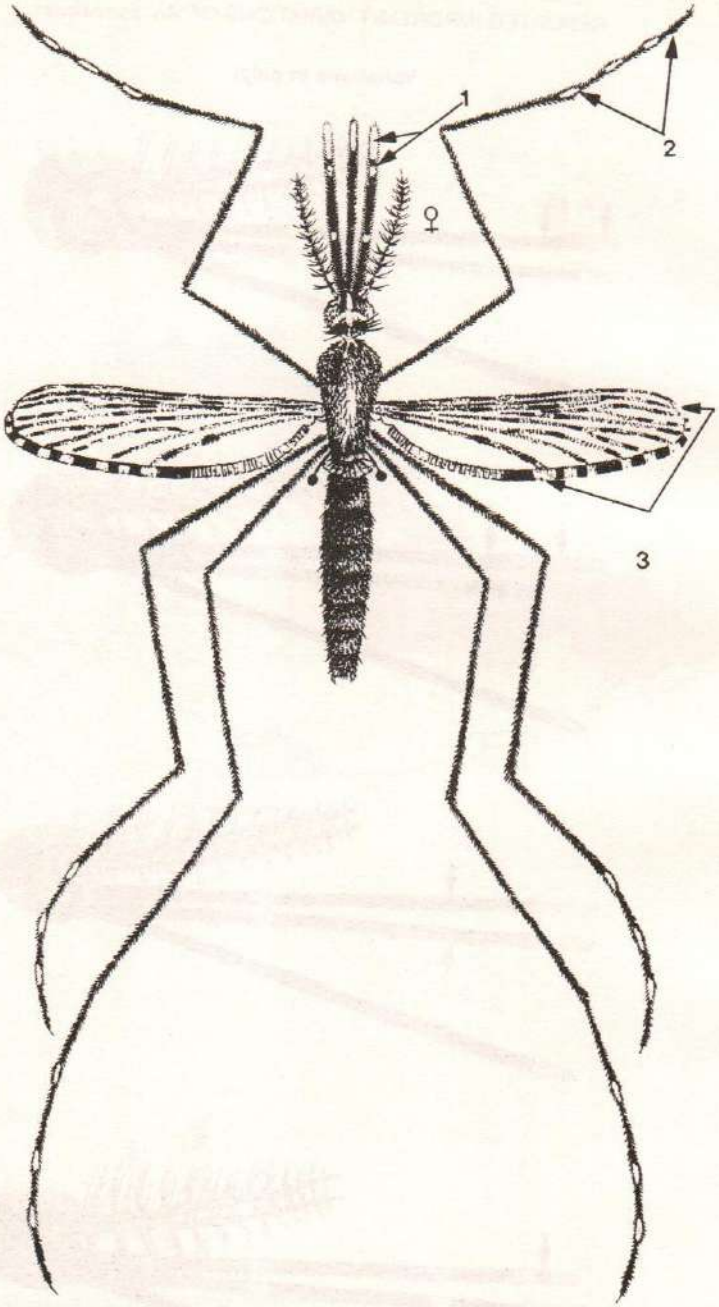


Reported distribution of *An. sundaicus* in India.

REPORTED IMPORTANT VARIATIONS OF *An. sundaicus*

Variations in palpi





An. vagus Doenitz 1902, main identification characters

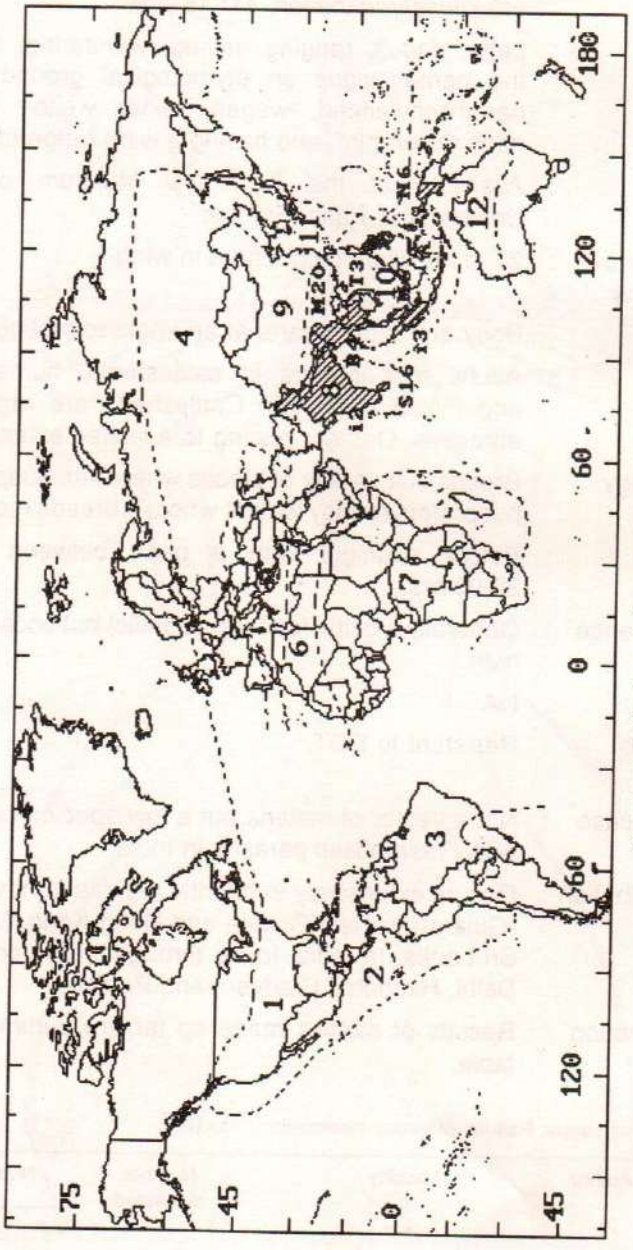
1. Pre-apical dark band 1/4 or 1/5 of the apical pale band.
2. Fore leg tasomeres with broad bands
3. Fringe spot on all the veins.

Anopheles vagus

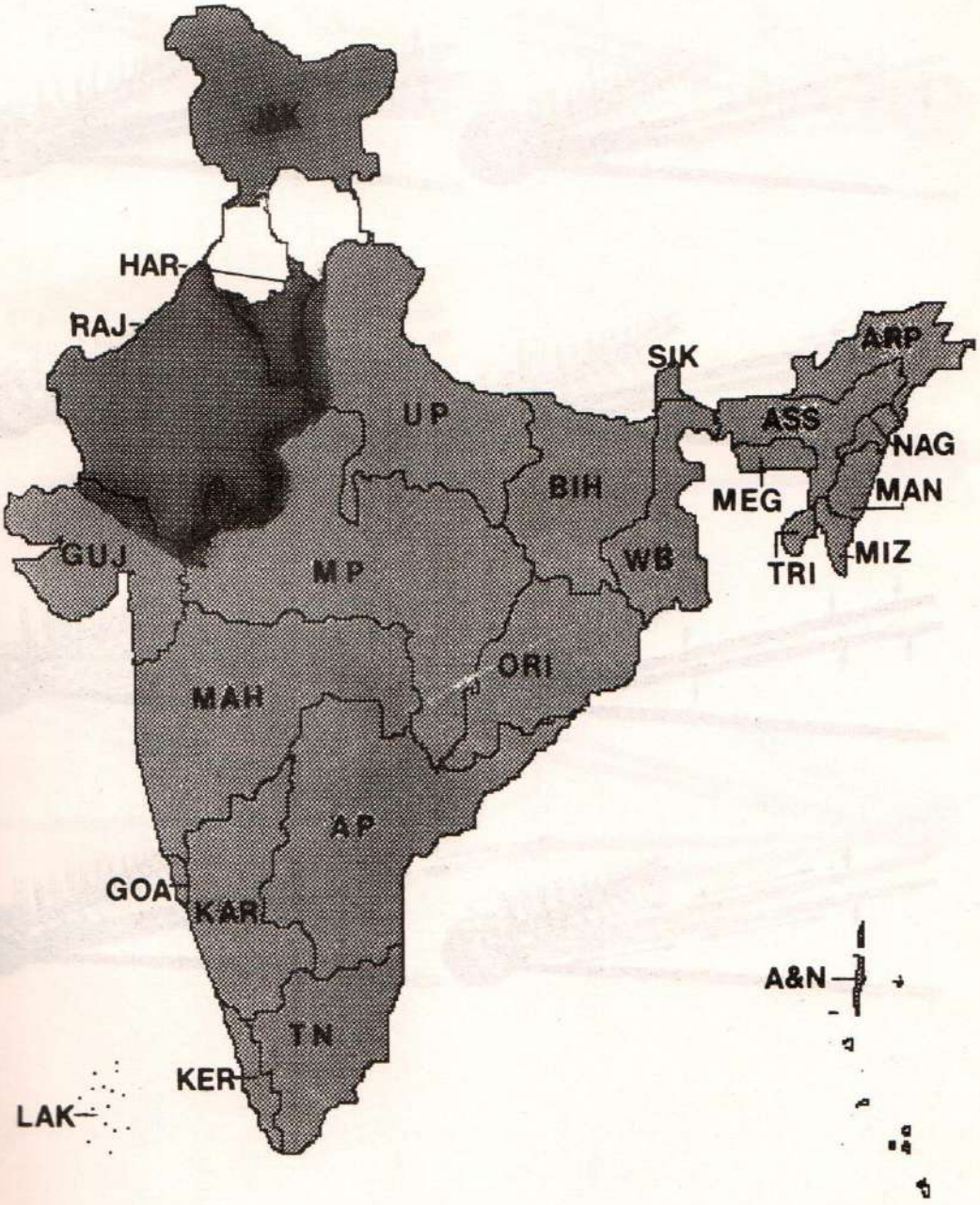
Name	:	*An. vagus* Donitz, 1902. *Zeitschrift fur Hygiene und Infektionskrankheiten*, **41:** 15–88.
Derivative	:	Latin, *vagus*, ranging, roving, wandering. Donitz gave the name *vagus* on etymological grounds "vagus = herumschweifend, wegen seiner weiten Ausbreitung nach Osten hin", and having a wide range of distribution.
Type form	:	Available at the Zoological Museum of Humboldt University of Paris, France.
Reported morphological variations	:	21 in maxillary palpi and 6 in wing
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Adults rest indoors in cattlesheds, human dwellings and mixed dwellings. Cattlesheds are regarded more attractive. Outdoor resting to a limited extent.
Breeding ecology	:	Breeds in a variety of places where *An. subpictus* breeds but prefers muddy waters where it breeds more intensely.
Biting time	:	Before midnight with a peak between 18.00 and 20.00 hrs.
Feeding preference	:	Generally a cattle feeder (zoophilic) but occasionally bites man.
Flight range	:	NA
Susceptibility to insecticides	:	Resistant to DDT.
Relation to disease	:	Not a vector of malaria but a few specimens were found with *Plasmodium* parasite in India.
Reported distribution	:	Occurs extensively in oriental regions from western India (Gujarat) to New Guinea and Hong Kong, Moluccas and Sri Lanka. In India, found throughout the country except Delhi, Himachal Pradesh, and Punjab.
Vector incrimination	:	Results of studies made so far are summarized in the table.

Table : *Anopheles vagus*: Results of vector incrimination studies

Sl. No.	Year	Author	Locality	Number dissected	Number Positive		
					Gut	Gland	Total
1.	1929	Strickland	Assam	1341	1	0	1
2.	1933	Strickland *et al.*	West Bengal	10452	0	2	2
3.	1939	Russell *et al.*	Madras, Tamil Nadu	3128	1	0	1
4.	1940	Russell & Rao	Madras, Tamil Nadu	6874	0	1	1



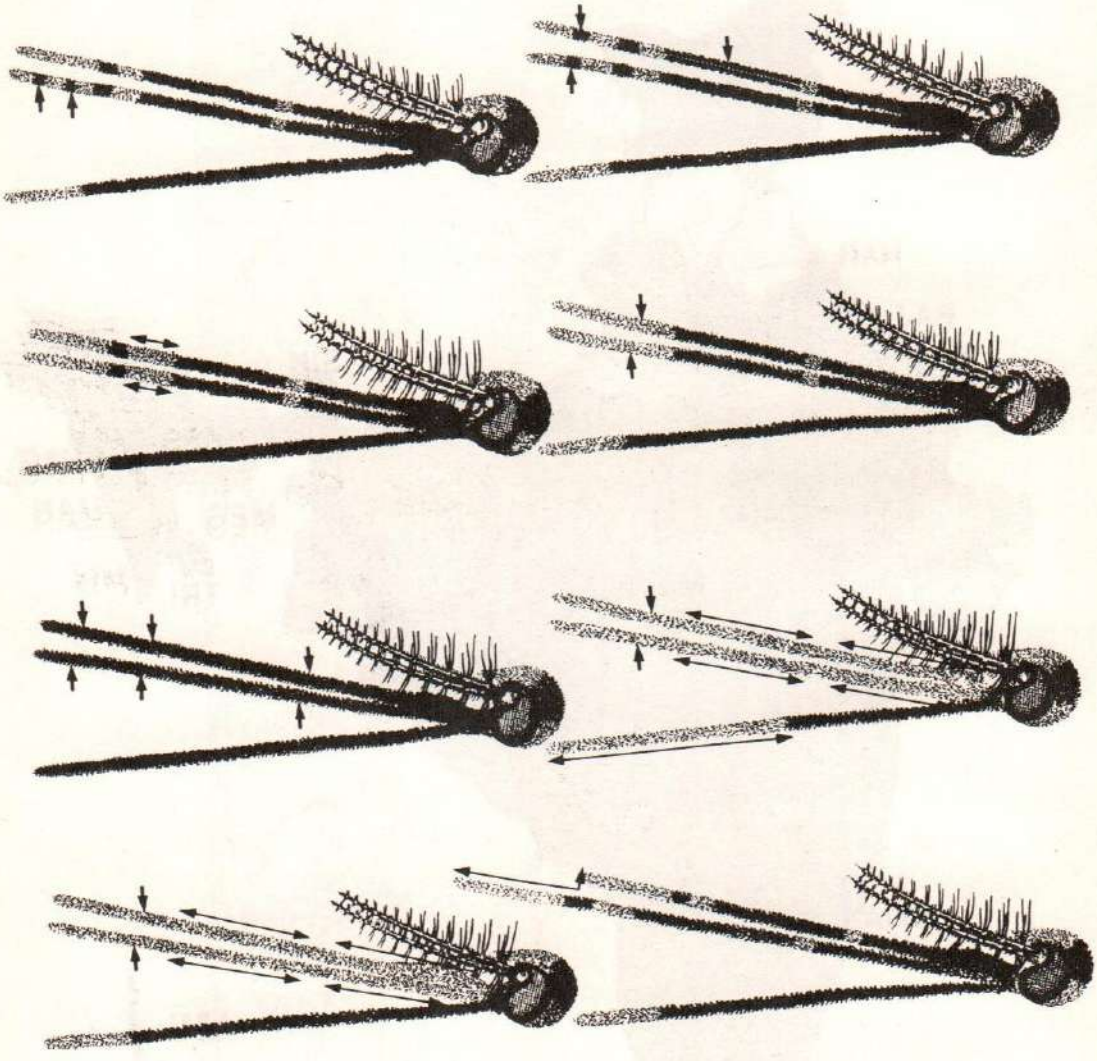
Reported distribution of *An. vagus* in the World.



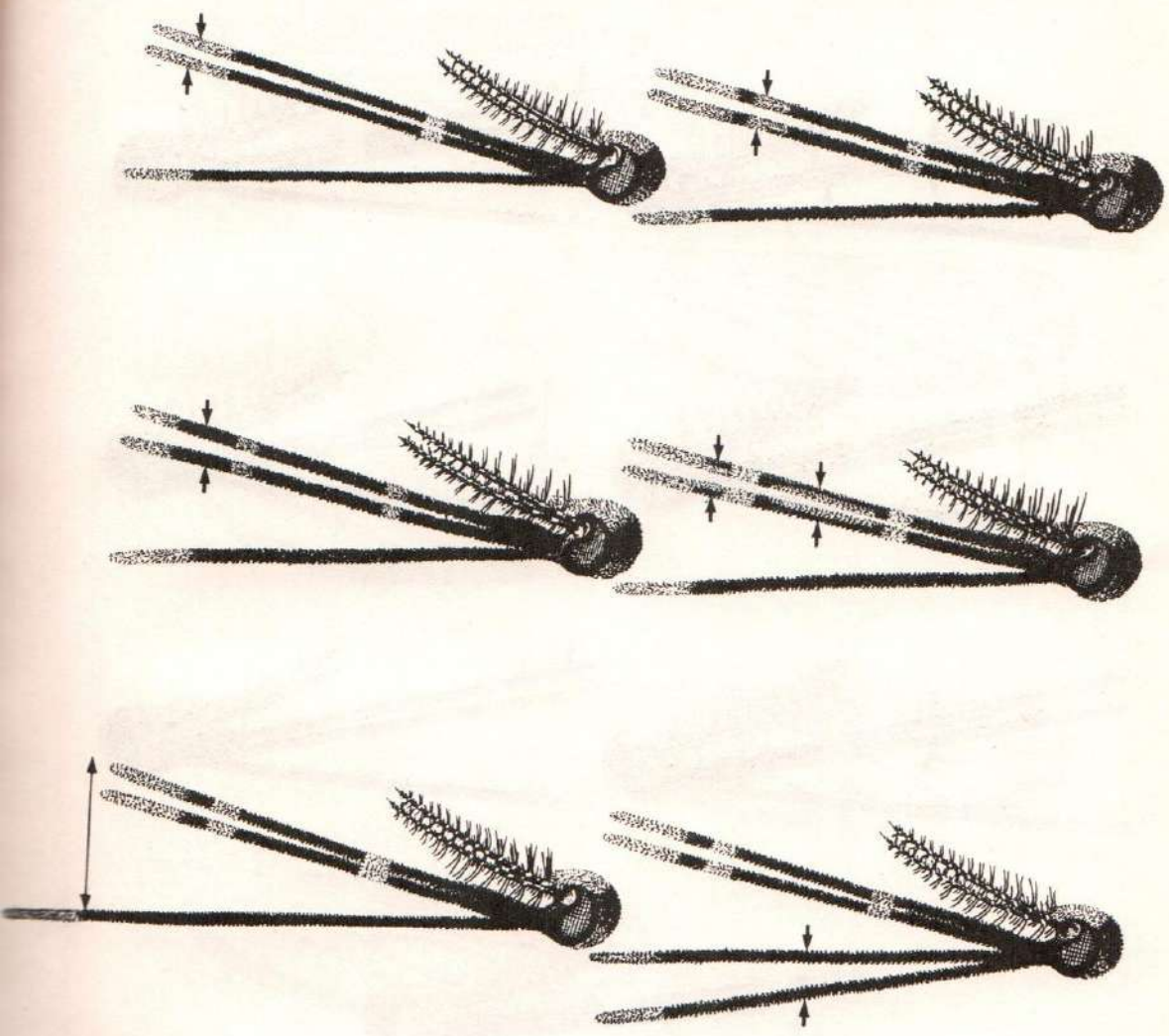
Reported distribution of *An. vagus* in India.

REPORTED IMPORTANT VARIATIONS OF *An. vagus*

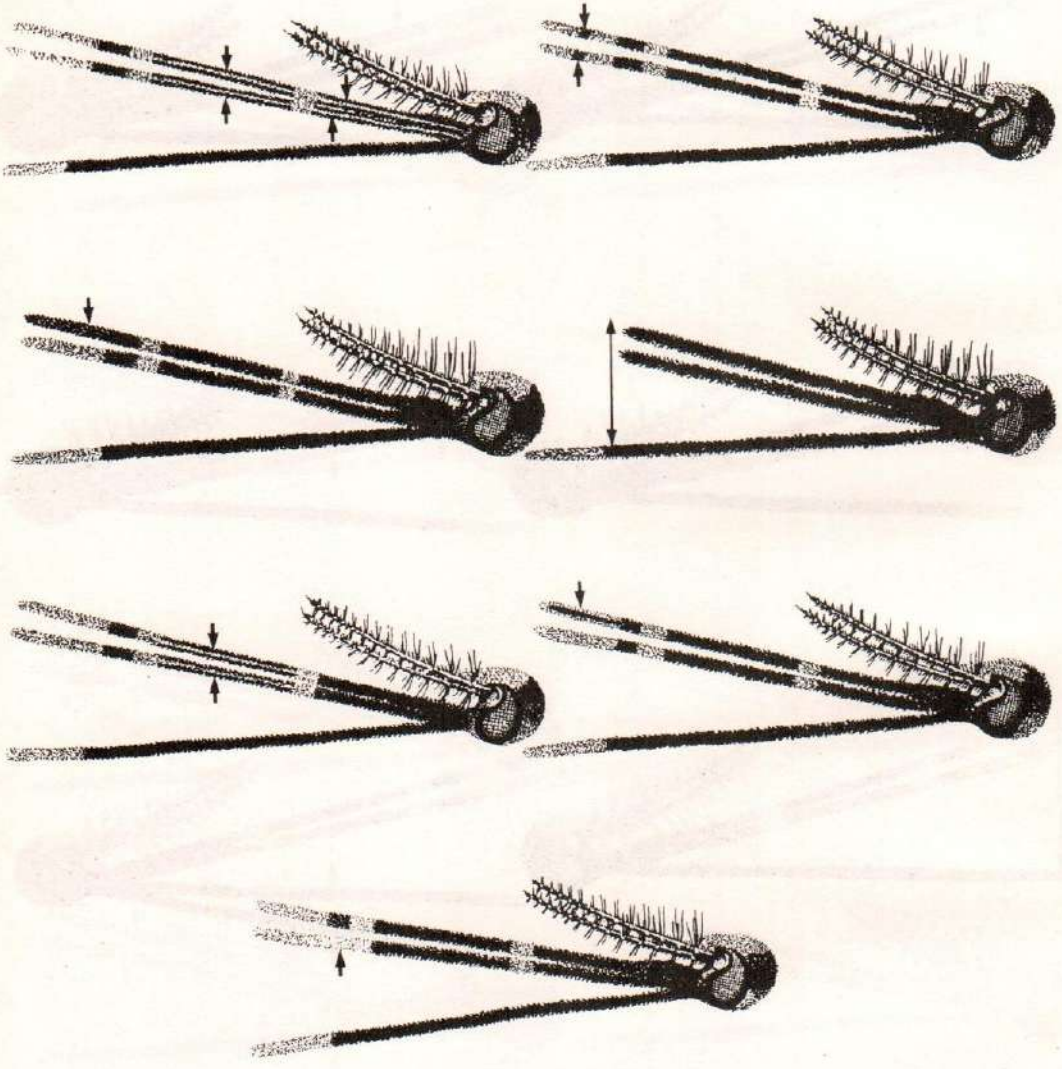
Variations in palpi



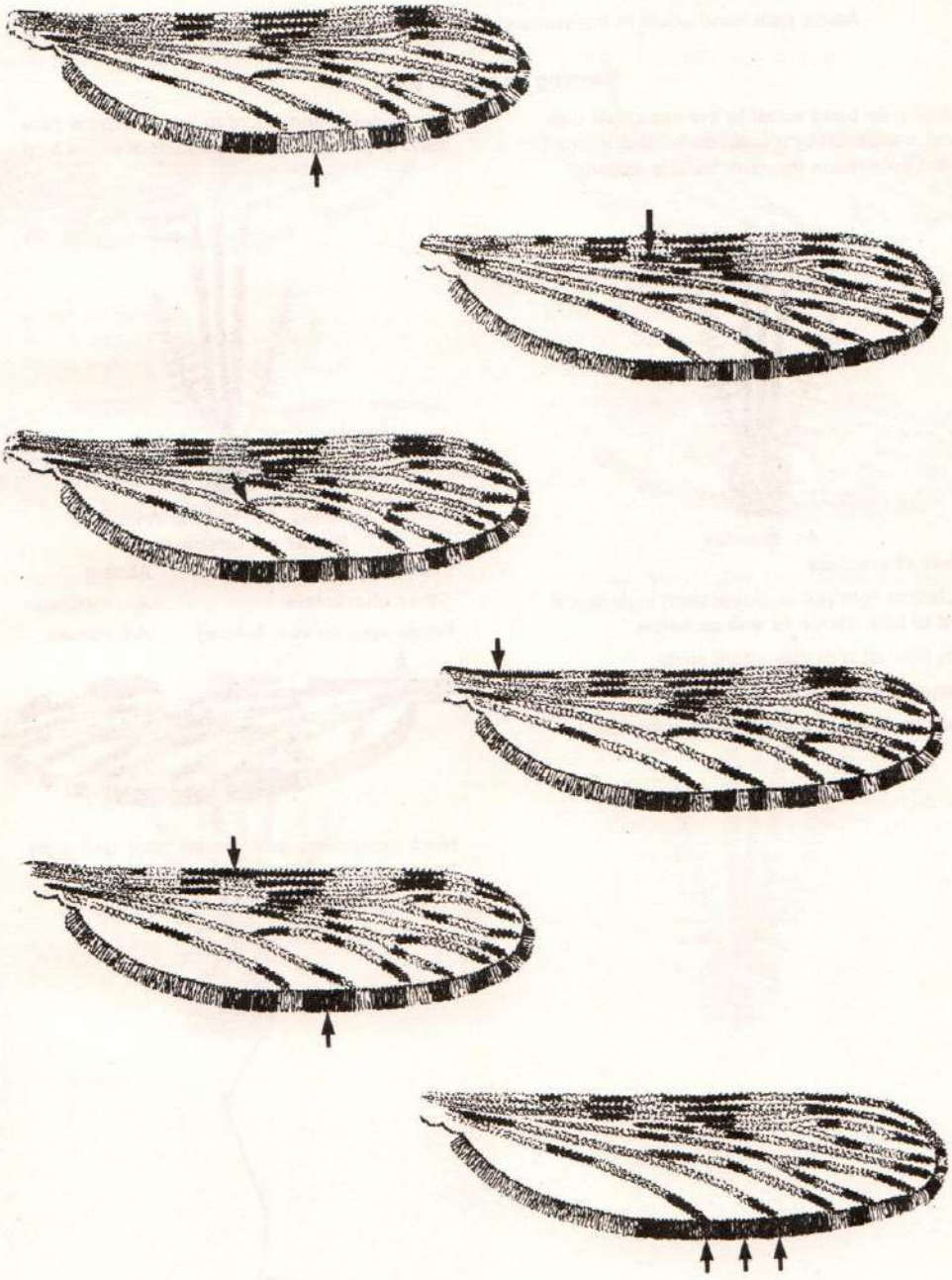
Variations in palpi



Variations in palpi



Variations in wing



1.5. An. minimus, An. varuna, An. aconitus, An. majidi

Wing with 4 or more pale areas on the costa, subcosta including vein 1(R1)

Apical pale band equal to the subapical pale band separated by a dark band

Banding pattern of palpi

Apical pale band equal to the subapical pale band, separated by a small dark band. In most of the specimens the dark band is absent

An. aconitus

Other characters

Proboscis light yellow (flavescent) in its apical third to half, above as well as below

Vein 6(Anal) with three dark spots

Fringe spot on vein 6(Anal)

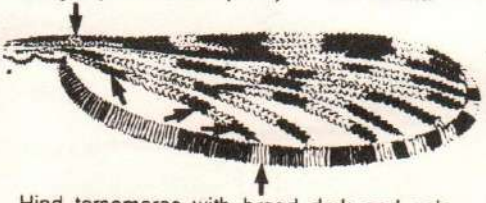
Inner costa may or may not be interrupted

Apical pale band equal to the subapical pale band separated by a dark band of equal size

An. minimus, An. varuna, An. majidi

Bands on tarsomeres

Present	Absent
Other characters	*An. minimus*
Fringe spot on vein 6(Anal)	*An. varuna*



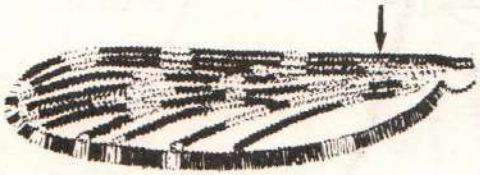
Hind tarsomeres with broad dark and pale bands and tip of the tarsomeres pale

An. majidi

An. minimus, An. varuna

Inner costa

Completely dark

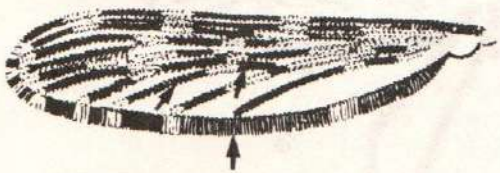


An. varuna

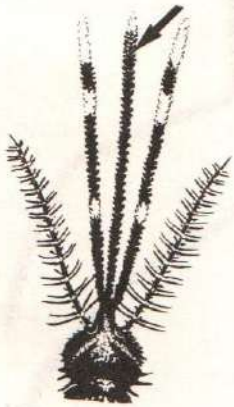
Other characters

Vein 5.1(Cu1) with 2 dark areas

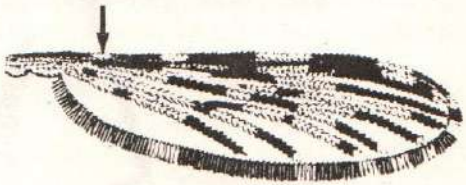
Fringe spot absent on vein 6(Anal)



Proboscis mostly dark but sometimes half of it yellow



Interrupted at least in one wing

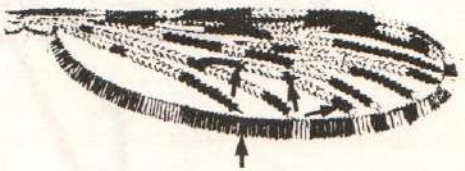


An. minimus

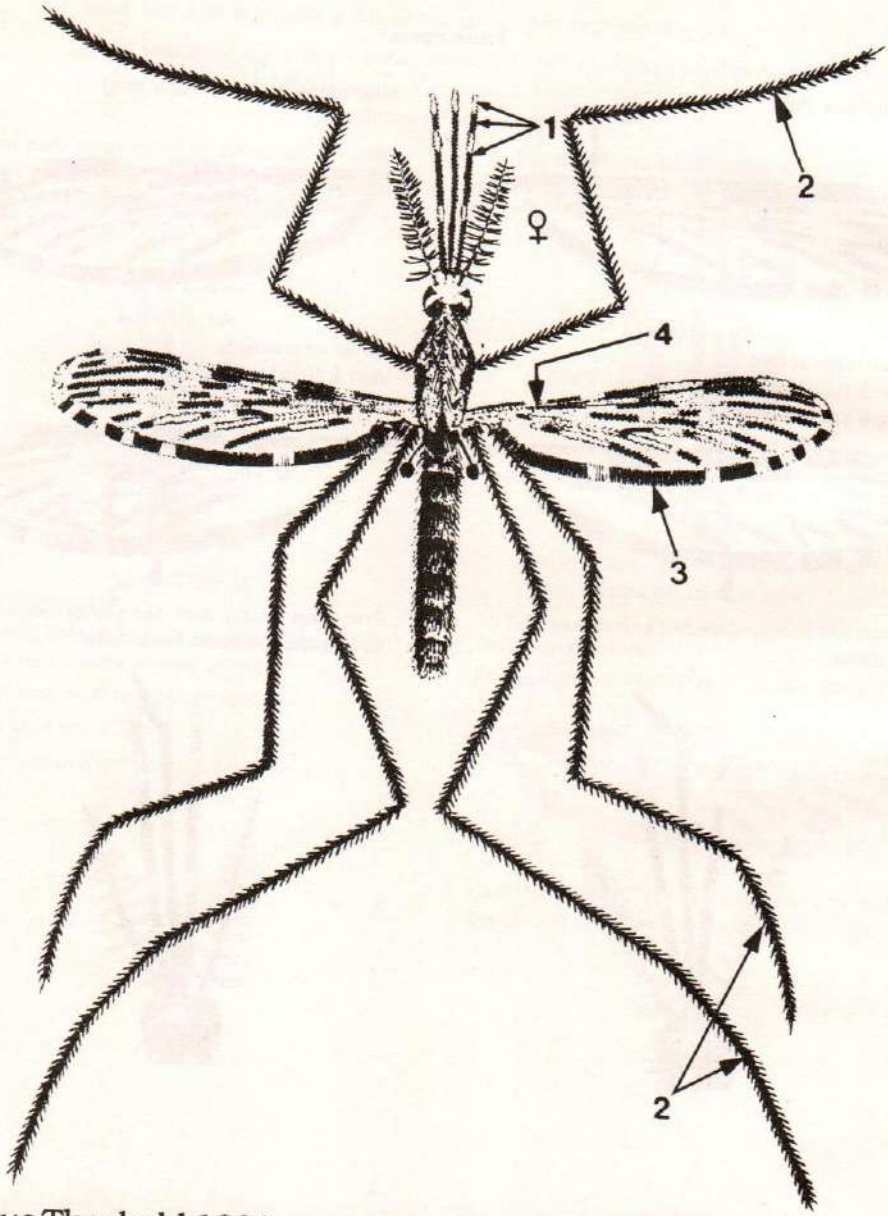
Other characters

Vein 5.1(Cu1) with 3 dark areas

Fringe spot absent on vein 6(Anal)



Proboscis mostly dark but sometimes shows flavescence towards lower side



An. minimus Theobald 1901, main identification characters

1. Apical and subapical pale bands equal and separated by a dark band.
2. Tarsomeres without bands.
3. Fringe spot absent on vein 6 (Anal vein).
4. Inner costa interrupted.

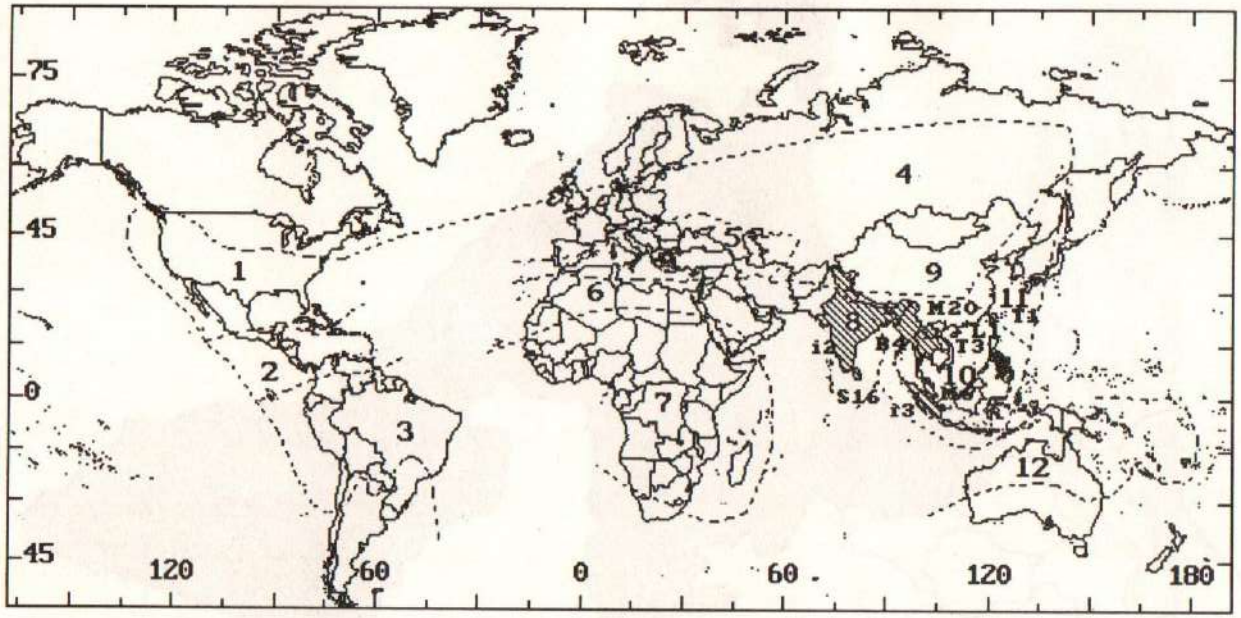
Anopheles minimus

Name	:	*An. minimus* Theobald, 1901. *A. Monograph of the Culicidae or Mosquitoes*, **1:** 186–188.
Derivative	:	Latin, *minimus*, smallest, very small; superlative of *parvus*, small. Theobald so named the species because of its very small size (3 mm).
Type form	:	Location not known.
Reported morphological variations	:	1 in wing
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Rests in houses and cattlesheds during the day. Recent studies show that this species rests mostly outdoors. Collected up to 1,600 m.
Breeding ecology	:	Larvae are generally found in streams, ditches, channels in tea gardens, drains, etc. which have a perceptible but slow flow of water. Occasionally it also breeds in borrowpits, ricefields and seepages. The species prefers shady places.
Biting time	:	Peak biting time is between 18.00 and 19.00 hrs, outdoors and between 24.00 and 2.00 hrs indoors. Biting time varies from locality to locality and from season to season.
Feeding preference	:	Prefers human blood and it is one of the most anthropophilic species of the oriental region.
Flight range	:	More than 2 km. Migrations recorded up to 12 km.
Susceptibility to insecticides	:	Susceptible to DDT.
Relation to disease	:	The species is a primary vector of malaria all over its range of occurrence in the foothill areas of the oriental region, e.g. Bangladesh, India, Cambodia, Laos, Myanmar, Nepal, Thailand, and Vietnam.
Reported distribution	:	Occurs in Bangladesh, South China, India, Indochina, Indonesia, Cambodia, Laos, Malaysia, Myanmar, Nepal, Sri Lanka, Thailand, Vietnam, Hong Kong, Ryukyu Island, and Taiwan. In India widely prevalent in Arunachal Pradesh, Assam, Madhya Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura. Also recorded from scattered places in Andhra Pradesh, Bihar, Karnataka, Kerala, Orissa, Tamil Nadu, West Bengal, and foothills of Uttar Pradesh.
Vector incrimination	:	Results of studies made so far are summarized in the table.

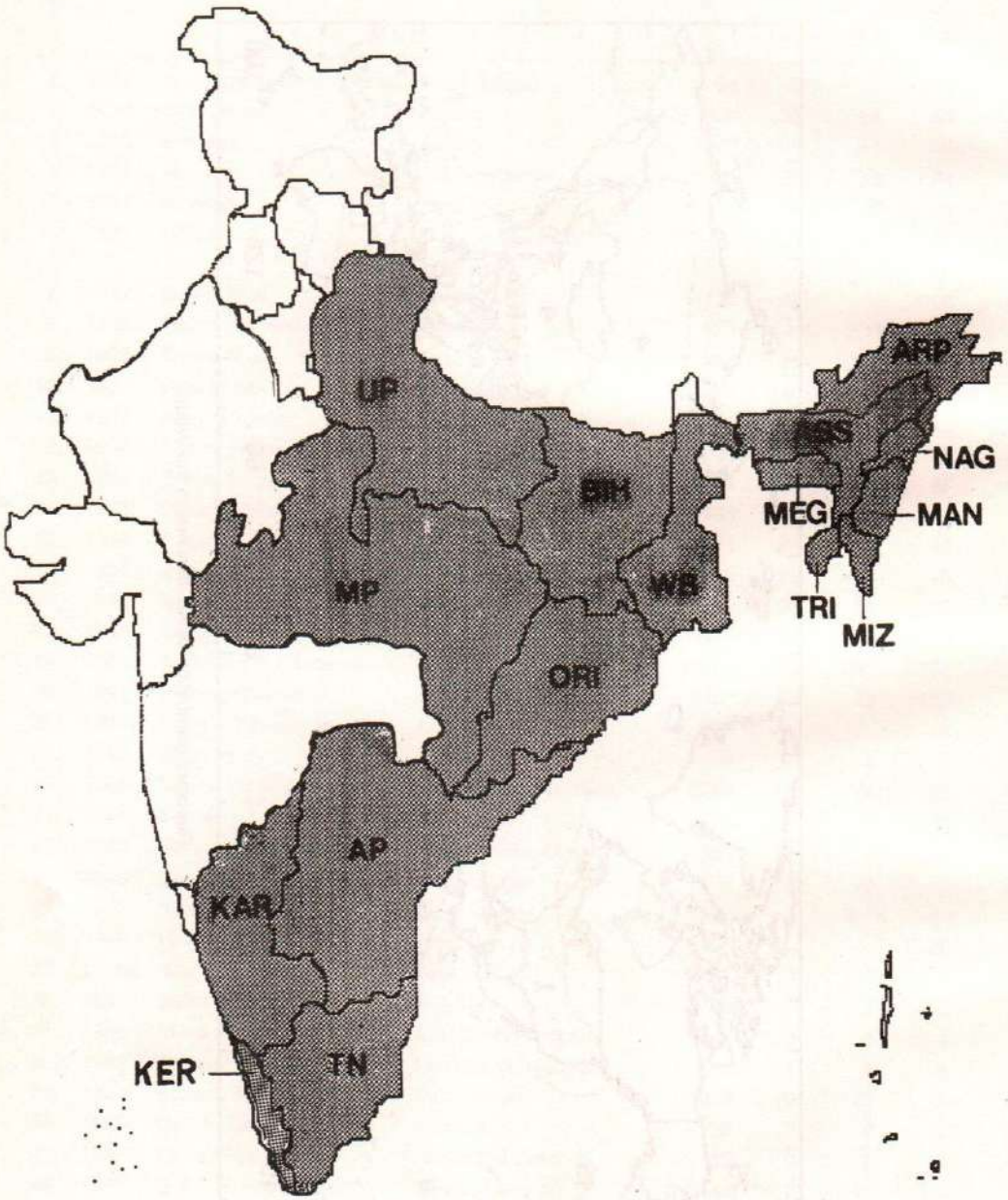
Table : *Anopheles minimus:* Results of vector incrimination studies

Sl. No.	Year	Author	Locality	Number dissected	Number Positive		
					Gut	Gland	Total
1.	1902	Stephens & Christophers	West Bengal	64	0	4	4
2.	1929	Strickland	Assam	1489	39	19	58
3.	1930	Ramsay	Assam	3847	59	27	86
4.	1931	Ramsay	Jorhat, Assam	1221	26	38	64
5.	1931	Manson	Assam	110	0	3	3
6.	1931	Clyde	U.P. Terai, Nainital Uttar Pradesh	1221	26	38	64
7.	1932	Gupta *et al.*	Assam	1119	91	9	100
8.	1933	Manson & Ramsay	Assam	NM	1.4%	2.1%	—
9.	1933	Gupta *et al.*	Assam	934	41	12	53
10.	1936	Paul *et al.*	Assam	NM	0.67%	0.67%	1.35%
11.	1937	Niogi & Khan	Jalpaiguri, West Bengal	8385	—	—	513
12.	1937c	Senior White	Jeypore hills, Orissa	201	17	8	25
13.	1938	Senior White & Das	Singhbhum hills, Bihar	334	23	13	36
14.	1938	Senior White	Jeypore hills, Orissa	7195	367	295	662
15.	1939	Gilroy	Darjeeling, West Bengal	421	35	6	41
16.	1939	Iyengar	West Bengal	719	25	18	43
17.	1940	Iyengar	West Bengal	172	20	16	36
18.	1940	Senior White & Narayana	Singhbhum hills, Bihar	124	12	7	19
19.	1941	Anderson & Viswanathan	Assam	14092	393	391	784
20.	1941	Viswanathan *et al.*	Assam & Meghalaya	5102	83	72	155
21.	1941	Clark & Choudhury	Assam	408	—	—	13
22.	1942	Khan	Assam	94	2	3	5
23.	1944	Senior White & Rao	Singhbhum hills, Bihar	2762	62	36	98
24.	1944	Covell	India	201	17	8	25
25.	1945	Senior White *et al.*	Jeypore hills, Orissa	161	15	7	22
26.	1946	Senior White & Ghosh	West Bengal	178	2	0	2
27.	1947	Puri & Krishnaswami	West Bengal	NM	—	3.1%	—
28.	1948	Ray	West Bengal	1090	—	—	32
29.	1948a	Sen	West Bengal	17	0	1	1
30.	1955	Misra & Dhar	Tripura	99	0	2	2
31.	1956	Misra	Arunachal Pradesh	7	0	1	1
32.	1982	Bhatnagar *et al.*	Dimapur (Nagaland)	12	1	1	1
33.	1984	Annual Report NMEP	Boko, Assam	1256	0	45	45
34.	1985	Das & Baruah	Mizoram	58	0	2	2
35.	1987	Dutta & Baruah	Arunachal Pradesh	39	0	1	1
36.	1989	S & T Project Report	Sonapur, Assam	3543	2	121	123
37.	1990	S & T Project Report	Sonapur, Assam	5019	3	148	151

NM—Not Mentioned.



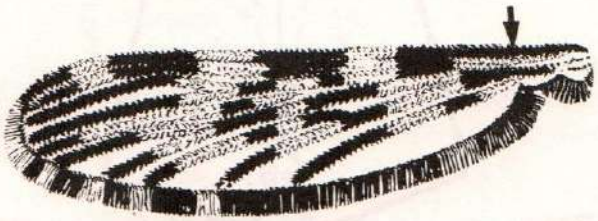
Reported distribution of *An. minimus* in the World.

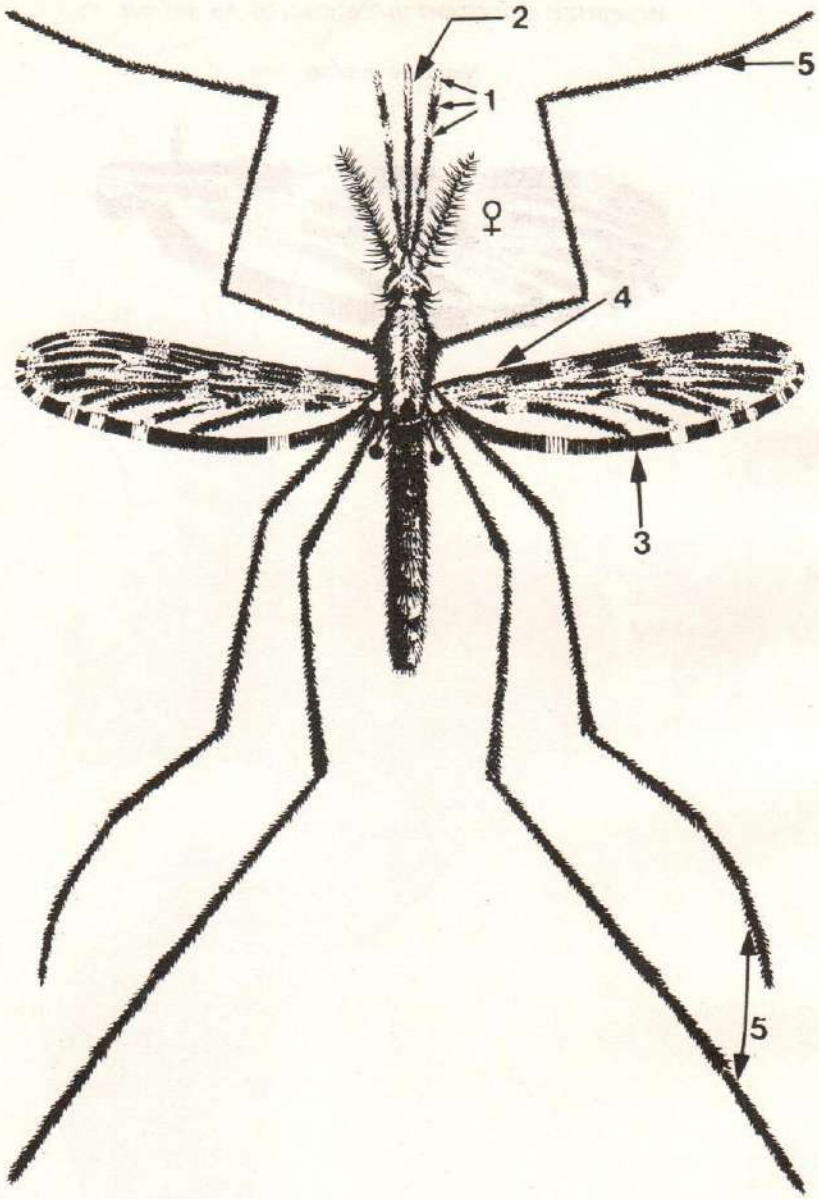


Reported distribution of *An. minimus* in India.

REPORTED IMPORTANT VARIATIONS OF *An. minimus*

Variation in wing





An. varuna Iyengar 1924, main identification characters

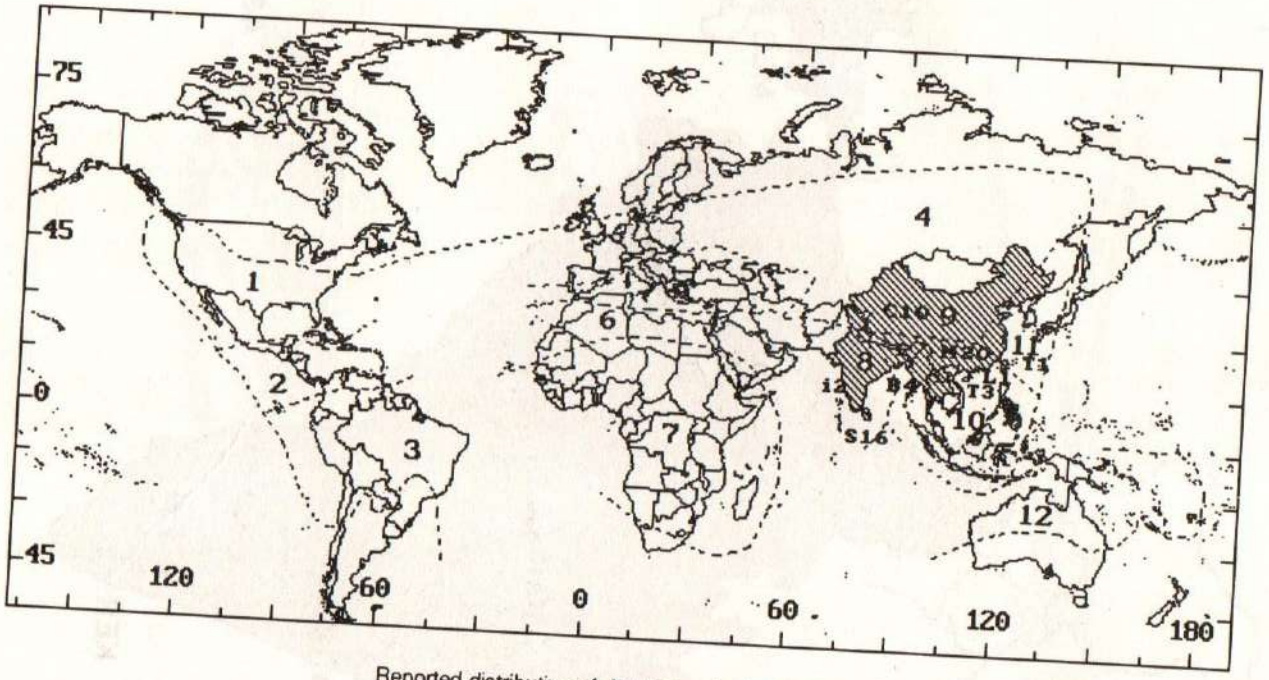
1. Apical and subapical pale bands equal and separated by a dark band.
2. Proboscis with flavescent.
3. Fringe spot absent on vein 6 (Anal vein)
4. Inner costa completely dark
5. Tarsomeres without bands

Anopheles varuna

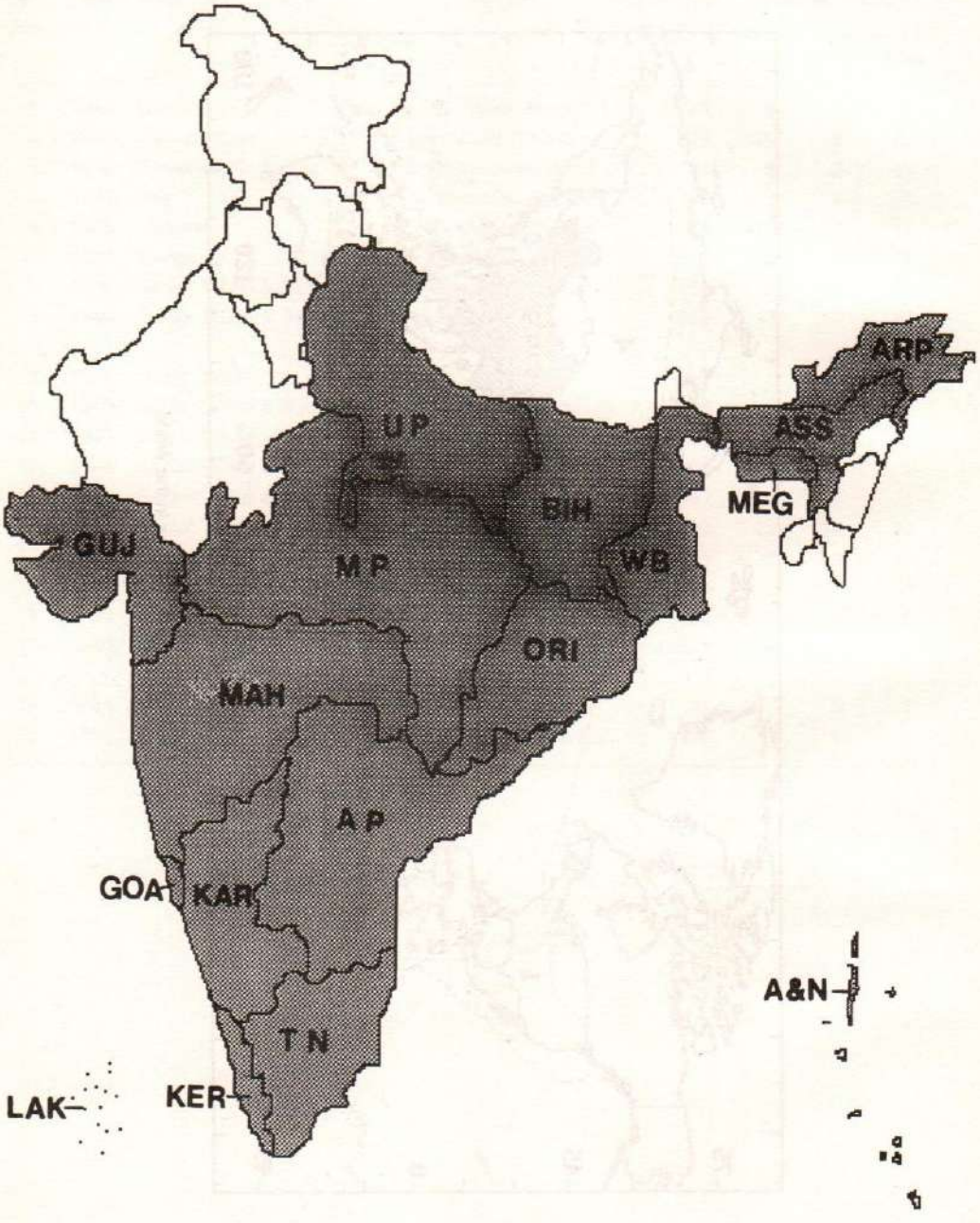
Name	:	*An. varuna* Iyengar, 1924. *The Indian Journal of Medical Research,* **12:** 23–29.
Derivative	:	Sanskrit, *varuna*, the God of Rain. This species is so named as it is the most prevalent during monsoon in Bengal, and breeds principally in rainwater collections.
Type form	:	Location not known.
Reported morphological variations	:	1 in maxillary palpi and 2 in wing
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Rests in houses, cattlesheds, and mixed dwellings. Also outdoors in foothill areas.
Breeding ecology	:	Breeds in a variety of places, both in stagnant and flowing waters. Breeds profusely in freshwater tanks, ponds, rice-fields, drains, irrigation channels, wells, etc. with algal and other aquatic vegetation.
Biting time	:	Bites man mostly between midnight and dawn depending on place. Biting time on cattle is between 18.00 and 22.00 hrs in Myanmar.
Feeding preference	:	Both cattle and human but prefers cattle.
Flight range	:	About 1 km.
Susceptibility to insecticides	:	NA
Relation to disease	:	A secondary vector of malaria in foothills of India, Myanmar and Sri Lanka.
Reported distribution	:	Found in Bangladesh, South China, India, Myanmar, Sri Lanka, and Thailand. In India, recorded from Andhra Pradesh (coastal), Arunachal Pradesh, Assam, Bihar, Goa, Gujarat, Kerala, Madhya Pradesh, Meghalaya, Orissa, Tamil Nadu, and Uttar Pradesh. Also recorded from Lakshadweep and Andaman Islands.
Vector incrimination	:	Results of studies made so far are summarized in the table.

Table : *Anopheles varuna:* Results of vector incrimination studies

Sl. No.	Year	Author	Locality	Number dissected	Number Positive		
					Gut	Gland	Total
1.	1928	Iyengar	Hoogly, West Bengal	25	0	1	1
2.	1938	Senior White	Jeypore hills, Orissa	225	20	9	29
3.	1938	Senior White & Das	Singhbhum hills, Bihar	189	8	2	10
4.	1939	Roy	Calcutta, West Bengal	113	0	4	4
5.	1939	Mathew	S. Travancore, Kerala	429	10	7	17
6.	1940	Iyengar	West Bengal	511	1	0	1
7.	1940	Senior White & Narayana	Singhbhum hills, Bihar	153	8	3	11
8.	1940	Senior White & Adhikari	E. Satpuras, Madhya Pradesh	386	13	12	25
9.	1941	Senior White	Madras, Tamil Nadu	59	1	0	1
10.	1943	Senior White & Rao	Coastal, Andhra Pradesh	11000	0	2	2
11.	1943	Senior White	Hazaribagh, Bihar	131	3	2	5
12.	1943	Senior White & Rao	Madras, Tamil Nadu	762	0	1	1
13.	1943	Senior White & Rao	Madras, Tamil Nadu	10567	0	1	1
14.	1945	Senior White *et al.*	Delhi, Union Territory	229	22	14	36
15.	1945	Senior White *et al.*	Singhbhum hills, Bihar	2188	3	0	3
16.	1946	Senior White & Ghosh	Bariguda, West Bengal	289	7	1	8
17.	1948	Sen	West Bengal	1000	1	4	5
18.	1980	Annual Report, NICD	Jagdalpur, Madhya Pradesh	19571	1	0	1
19.	1984	Mani *et al.*	Tamil Nadu	69	1	0	1
20.	1990	Kulkarni	Bastar, Madhya Pradesh	44	0	1	1



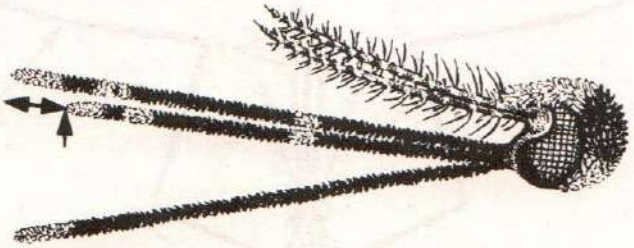
Reported distribution of *An. varuna* in the World.



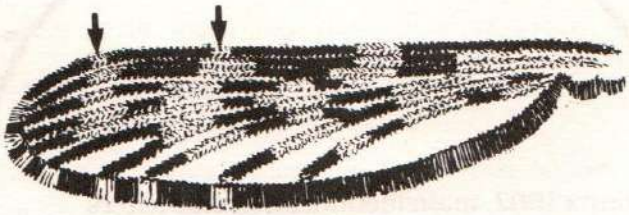
Reported distribution of *An. varuna* in India.

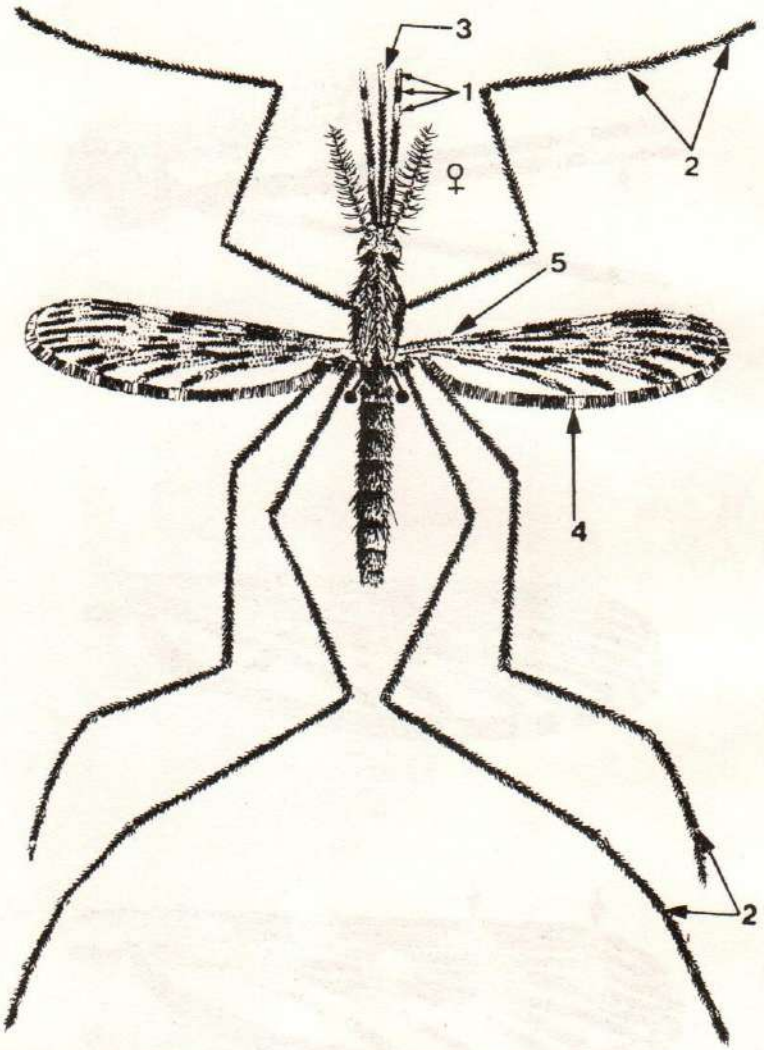
REPORTED IMPORTANT VARIATIONS OF *An. varuna*

Variation in palpi



Variations in wing





An. aconitus Donitz 1902, main identification characters

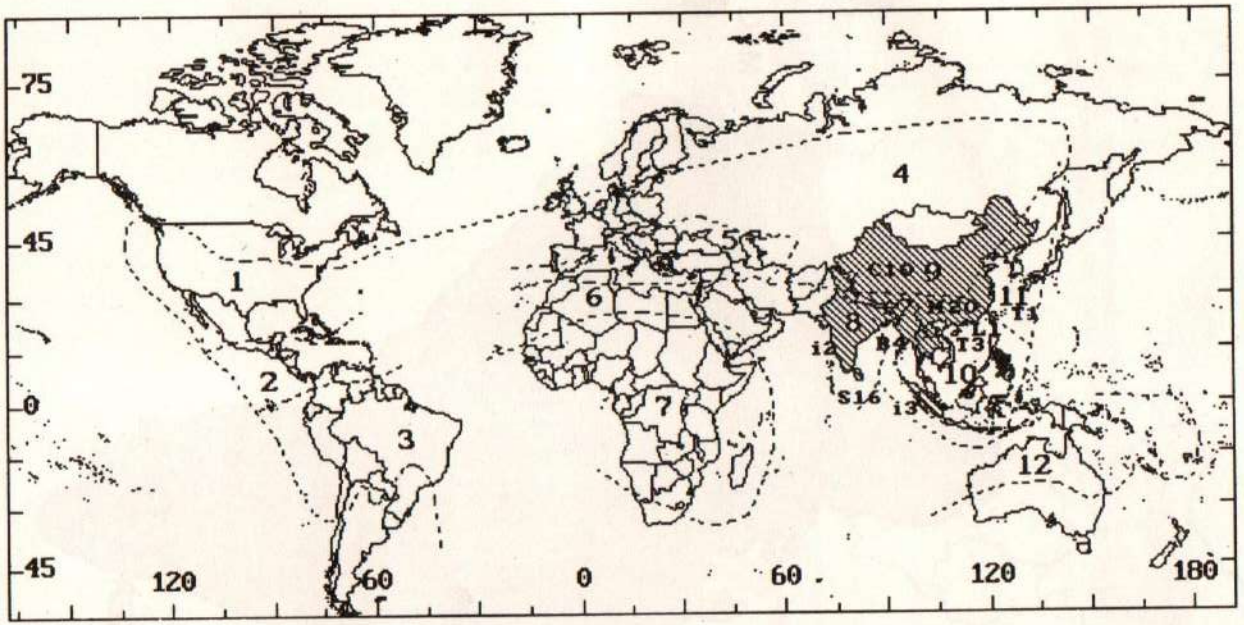
1. Apical and subapical pale bands equal and separated by a small dark band.
2. Tarsomeres without bands
3. Proboscis with flavescent
4. Fringe spot on vein 6 (Anal vein)
5. Inner costa interrupted

Anopheles aconitus

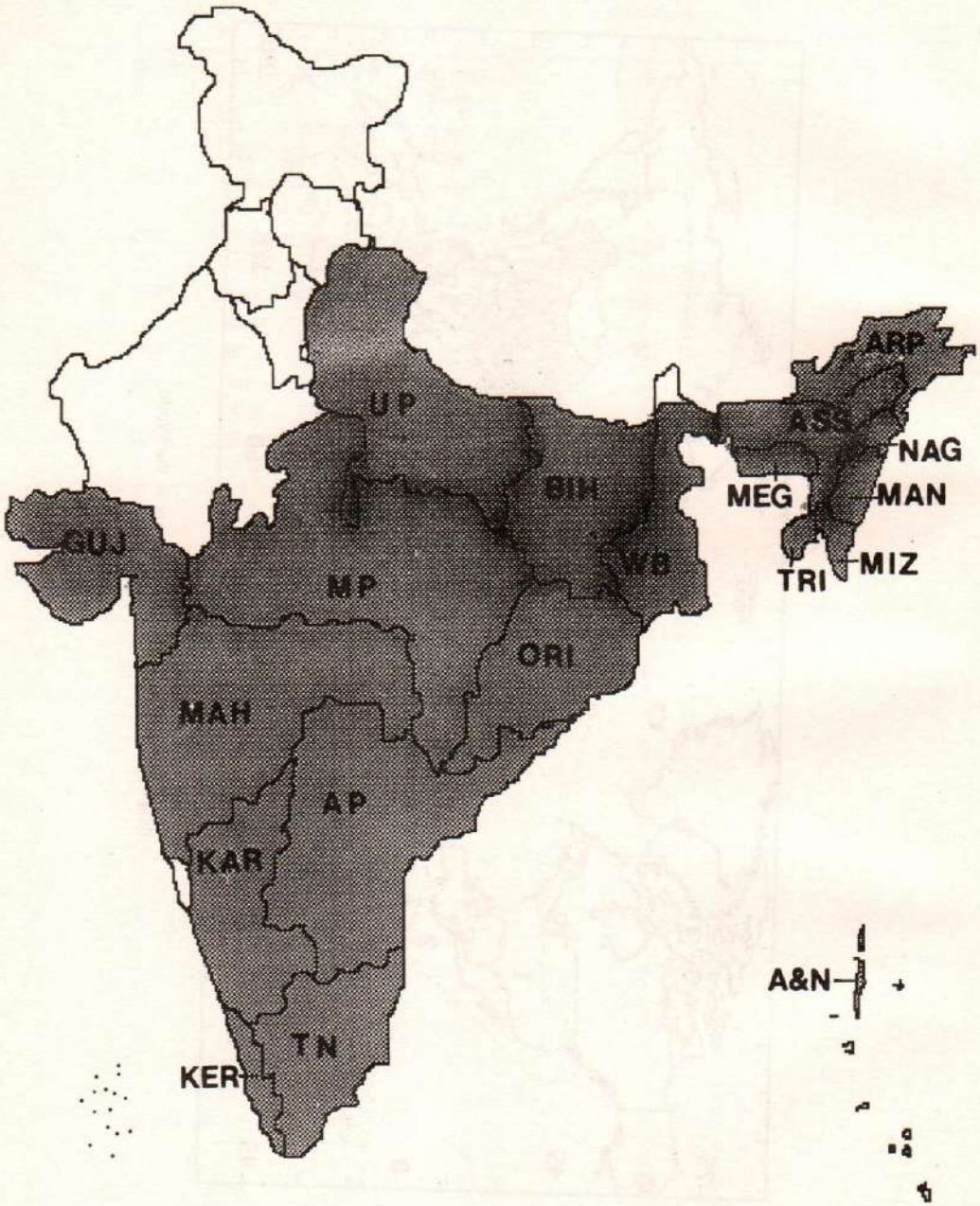
Name	:	*An. aconitus* Dönitz, 1902. *Zeitschrift Für Hygiene und Infektionskrankheiten.* **41:** 15–18.
Derivative	:	Greek, *a*, without; *konis*, dust, ashes; *itus*, adjectival suffix; Dönitz' meaning here is unequivocal.
Type form	:	Available at the Zoologisches Museum der Humboldt Universitaet, Berlin, West Germany.
Reported morphological variations	:	1 in maxillary palpi and 1 in wing
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Rests in houses and cattlesheds, but mostly in cattlesheds; also on bushes and banks of streams.
Breeding ecology	:	The species breeds in clean-water tanks with grassy edges, ponds, streams, water drains, river bed pools, and ricefields (at least 45 cm long). In Malaysia and Indonesia it is a swamp breeder.
Biting time	:	Biting starts at 18.00 hrs with a peak at 24.00 hrs and terminates at 01.00 hrs.
Feeding preference	:	Predominantly feeds on cattle but bites man to some extent.
Flight range	:	About 1 km.
Susceptibility to insecticides	:	Resistant to organochlorine pesticides.
Relation to disease	:	In India, regarded as a secondary vector next to *An. annularis* in the Orissa coastal plains. Of some importance in transmission in Java, Sumatra, Indonesia, and Malaysia.
Reported distribution	:	Occurs throughout the oriental regions from India to Indonesia and Indochina, in south to Sri Lanka. In India, recorded from Andaman Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Delhi, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Tamil Nadu, Tripura, Uttar Pradesh, and West Bengal.
Vector incrimination	:	Results of studies made so far are summarized in the table.

Table : *Anopheles aconitus*: Results of vector incrimination studies

Sl. No.	Year	Author	Locality	Number dissected	Number Positive		
					Gut	Gland	Total
1.	1937c	Senior White	Jeypore hills, Orissa	107	1	0	1
2.	1939	Senior White & Adhikari	Orissa, Chilka lake	481	1	0	1
3.	1941	Anderson & Viswanathan	Assam	1145	1	0	1
4.	1941	Viswanathan *et al.*	Assam	254	1	0	1
5.	1943	Senior White *et al.*	Coastal Orissa	951	3	2	5
6.	1943	Das	West Bengal	24	2	1	3
7.	1945	Senior White *et al.*	Jeypore hills, Orissa	68	1	0	1
8.	1989	Gunasekaran *et al.*	Koraput, Orissa	935	1	0	1



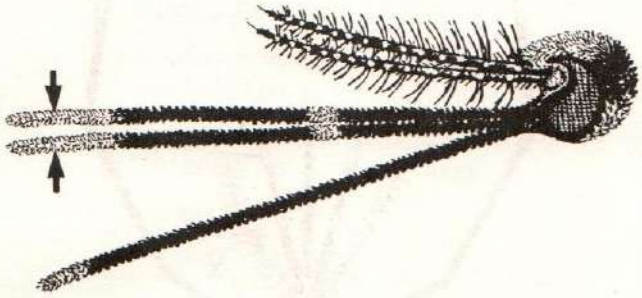
Reported distribution of *An. aconitus* in the World.



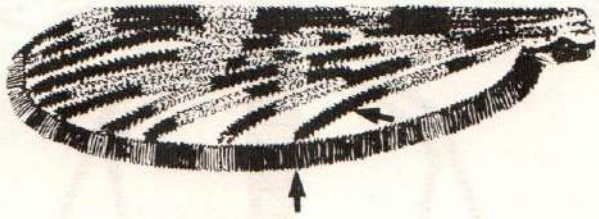
Reported distribution of *An. aconitus* in India.

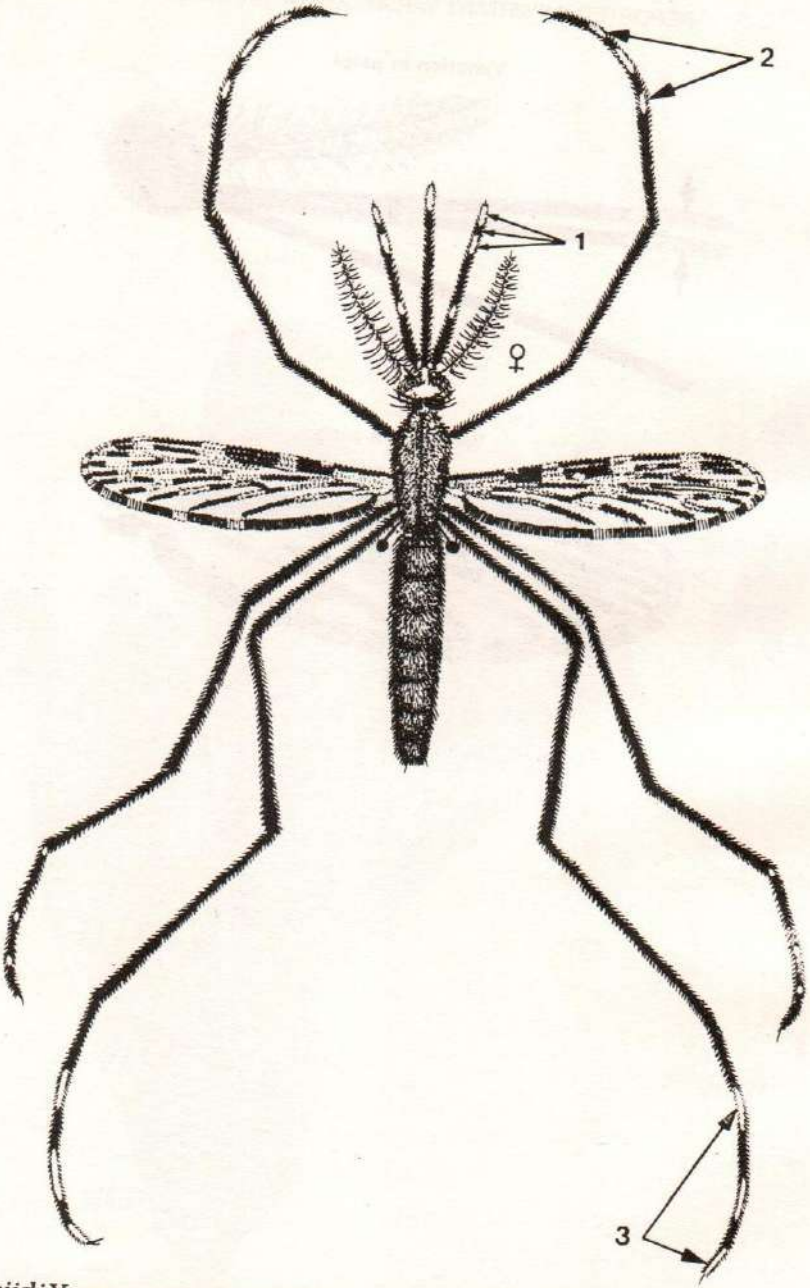
REPORTED IMPORTANT VARIATIONS OF *An. aconitus*

Variation in palpi



Variation in wing





An. majidi Young and Majid 1928, main identification characters

1. Apical and subapical pale bands equal and separated by a dark band.
2. Fore leg tarsomeres with broad bands
3. Hind leg tarsomeres banded as shown in figure

Anopheles majidi

Name	:	*An. majidi* Young and Majid, 1928. *The Indian Journal of Medical Research.* **16:** 469–471.
Derivative	:	Species named after one of the junior authors, Majid, who first collected it.
Type form	:	Available at the National Institute of Communicable Disease, Delhi 110 054, India.
Reported morphological variations	:	1 in leg
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	A very rare species, rests in houses and cattlesheds, also outdoors.
Breeding ecology	:	Breeds in grassy slow-running streams. Breeding also recorded from open drains in tea gardens and fallow ricefields.
Biting time	:	NA
Feeding preference	:	Man and cattle.
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	NA
Reported distribution	:	Occurs in India and Nepal. In India, reported from Arunachal Pradesh, Assam, Goa, Karnataka, Kerala, Meghalaya, Mizoram, Orissa, Tamil Nadu, Tripura, and West Bengal.
Vector incrimination	:	NA

Reported distribution of *An. majidi* in the World.

ASSAM (ASS)
1. Tejpur
2. Kamrup

ARUNACHAL PRADESH (ARP)
1. East Kameng

GOA (GOA)
1. Goa

KARNATAKA (KAR)
1. Shimoga
2. Chitradurga
3. Hassan
4. Kadur
5. Mysore
6. Coorg

KERALA (KER)
1. Wynaad

MEGHALAYA (MEG)
1. Shillong

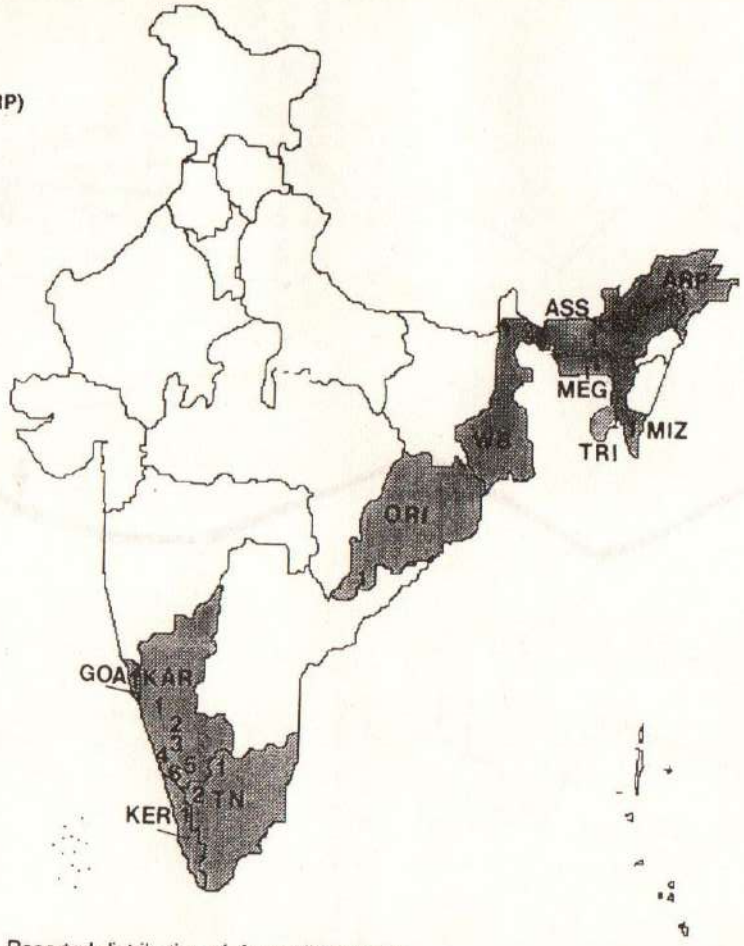
MIZORAM (MIZ)
1. Aizwal

ORISSA (ORI)
1. Koraput

TAMIL NADU (TN)
1. Annamalai hills
2. Nilgiris

WEST BENGAL (WB)
1. Darjeeling
2. Jalpaiguri

TRIPURA (TRI)
1. Agartala



Reported distribution of *An. majidi* in India.

REPORTED IMPORTANT VARIATIONS OF *An. majidi*

Variation in leg

1.6. An. stephensi, An. maculatus, An. willmorei, An. theobaldi, An. pseudowillmori

Wing with 4 or more pale areas on the costa, subcosta including vein 1(R1)

Two apical broad pale bands of the palpi separated by a small dark band

Legs with speckling

Banding on foreleg tarsomeres

Absent

An. stephensi

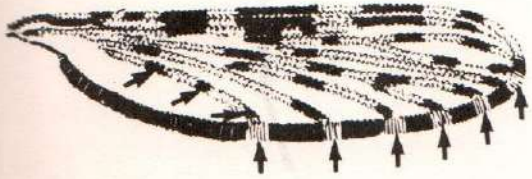
Present

An. maculatus, An. willmorei, An. theobaldi, An. pseudowillmori

Other characters

Palpi with speckling restricted to middle and basal dark band

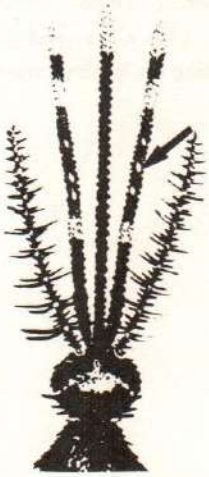
Fringe spot present on all the veins and vein 6(Anal) with 3 dark areas



Thorax with broad scales

An. maculatus, An. willmori, An. theobaldi, An. pseudowillmori

Palpi with or without speckling



Hind-leg tarsomeres

Fifth and fourth tarsomeres completely white

An. theobaldi

Fifth and fourth tarsomeres white but a dark band present on 4th tarsomeres

An. maculatus, An. willmori, An. pseudowillmori

An. theobaldi

Other characters

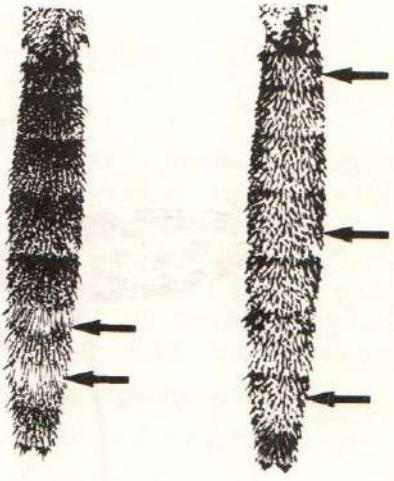
Base of costa darker than *An. maculatus*

An. maculatus, An. willmori, An. pseudowillmori,

Scaling on abdomen

Broad scales restricted to only two segments, i.e. 6 and 7

The whole area of tergites 2–7 with broad golden scales

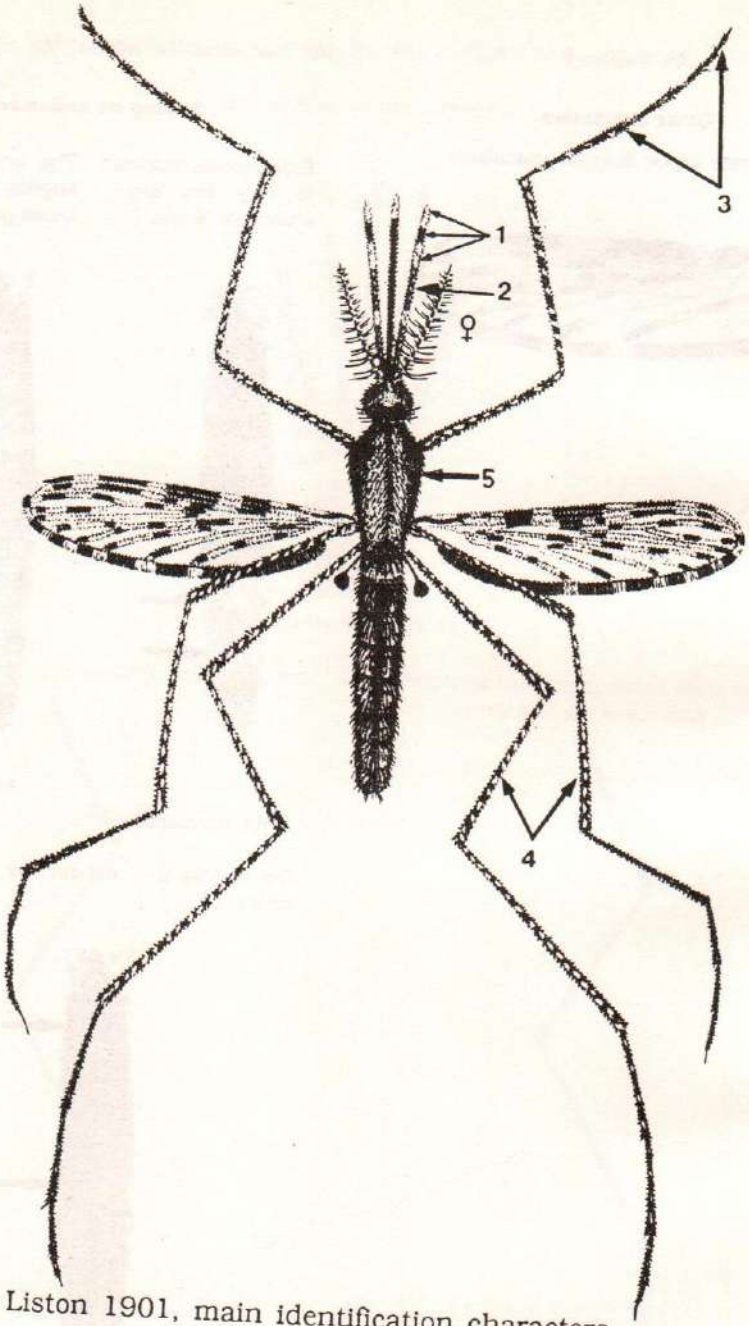


An. maculatus

An. willmori

The tergites 2–7 without any broad golden scales

An. pseudowillmori



An. stephensi Liston 1901, main identification characters

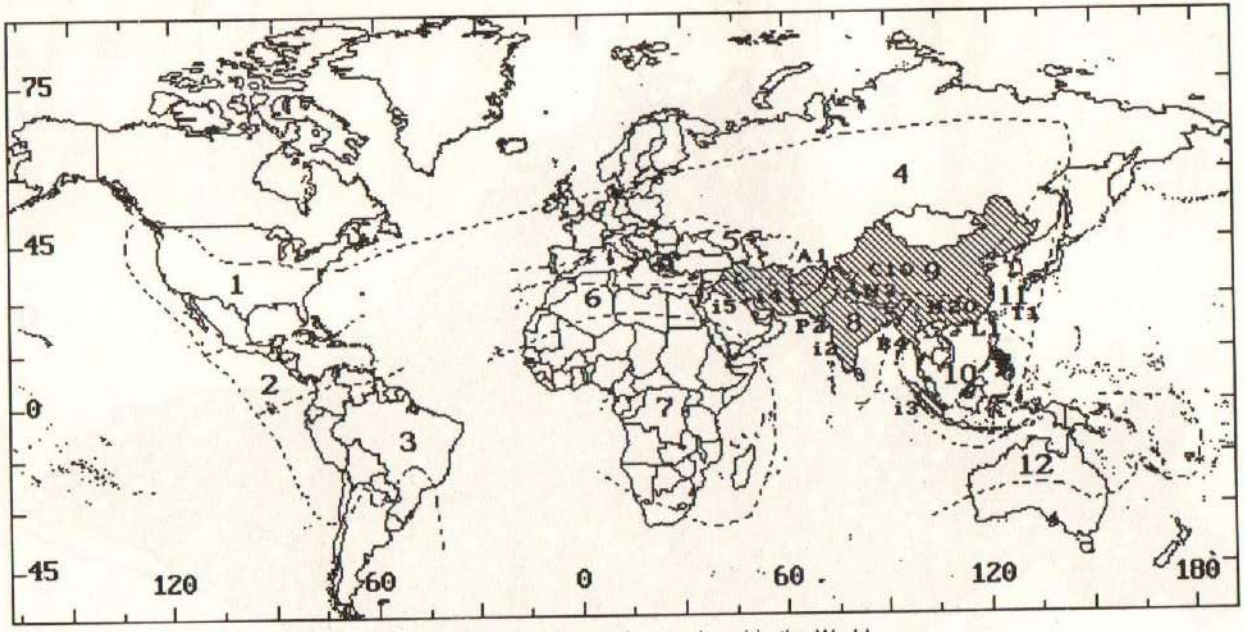
1. Apical and subapical pale bands equal and separated by a dark band.
2. Palpi with speckling.
3. Fore leg tarsomeres without broad bands.
4. Legs with speckling.
5. Thorax with broad scales.

Anopheles stephensi

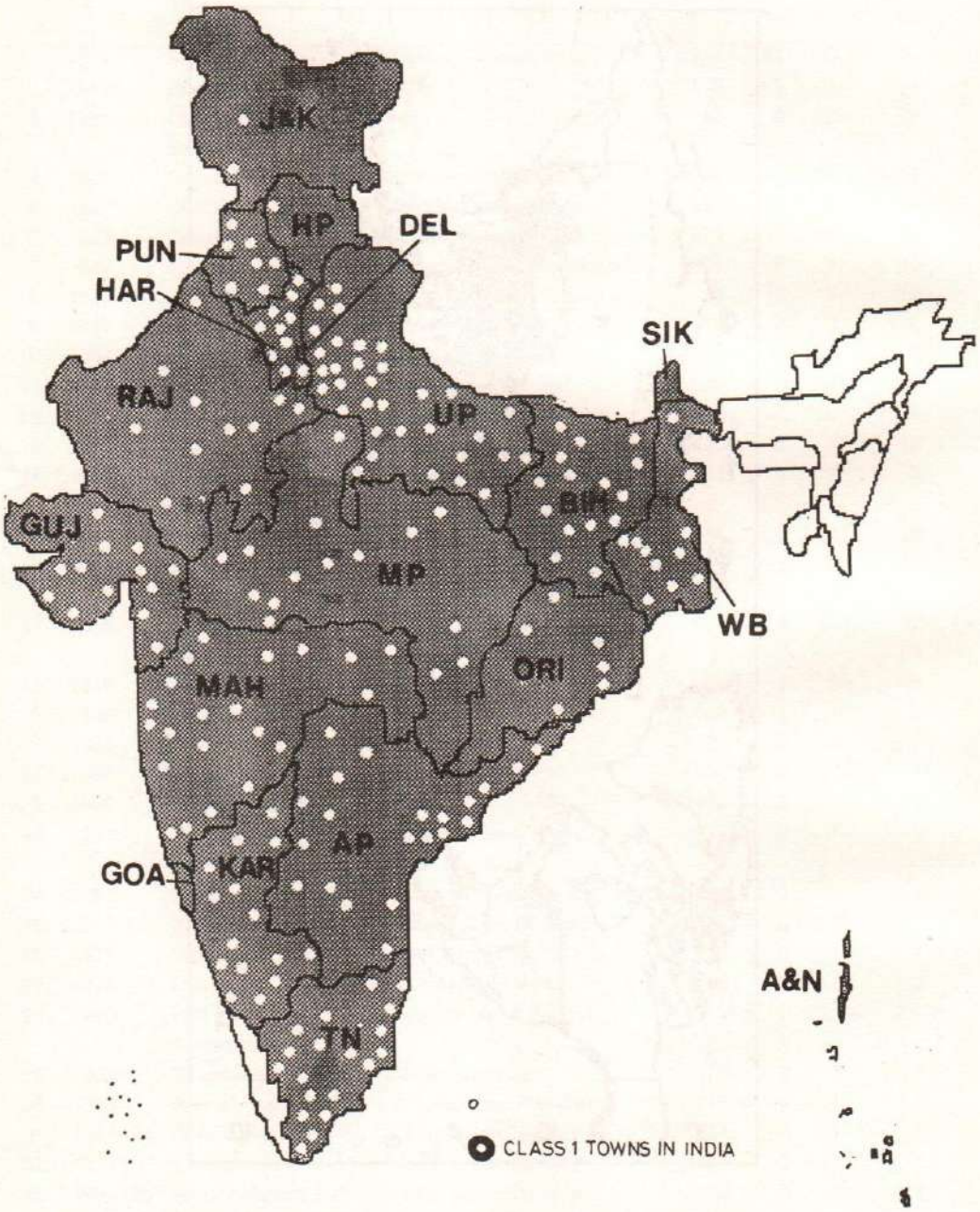
Name	:	*An. stephensi* Liston, 1901. *The Indian Medical Gazette,* **36:** 361–366, 441–443.
Derivative	:	Liston named it after J.W.W. Stephens.
Type form	:	Location not known.
Reported morphological variations	:	25 in maxillary palpi and 9 in wing.
Species complex	:	Earlier (Sweet & Rao, 1937) classified it into two varieties on the basis of ridges on egg float. These were named *An. stephensi stephensi* or type form and *An. stephensi mysorensis*. Type form is mainly urban whereas mysorensis is rural. Recent genetic studies have revealed three races, i.e. *An. stephensi stephensi*, *An. stephensi mysorensis* and *An. stephensi* intermediate.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Adults rest in houses, cattlesheds and barracks, etc.
Breeding ecology	:	In urban areas, predominantly breeds in wells, overhead or ground-level water tanks, cisterns, tanks, coolers, roof gutters, and other artificial containers. Scanty breeding is also reported in recent years from ricefields, and polluted and brackish water habitats. Larvae are shade lovers.
Biting time	:	Peak biting activity is generally between 22.00 and 24.00 hrs but varies from area to area and also from season to season.
Feeding preference	:	Predominantly on cattle in rural areas and human in urban areas.
Flight range	:	0.8–2.5 km.
Susceptibility to insecticide	:	Resistant to DDT, HCH and malathion in many places in India.
Relation to disease	:	Major urban malaria vector in India, Pakistan, Iran, and Iraq.
Reported distribution	:	Afghanistan, Bangladesh, China, India, Indochina, Iran, Iraq, Myanmar, Nepal, Pakistan, Taiwan, and Thailand. In India, found in Andaman & Nicobar Islands, Andhra Pradesh, Bihar, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kashmir, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh, and West Bengal.
Vector incrimination	:	Results of studies made so far are summarized in the table.

Table : *Anopheles stephensi:* Results of vector incrimination studies

S. No.	Year	Author	Locality	Number dissected	Number positive		
					Gut	Gland	Total
1.	1911	Bently	Bombay, Maharashtra	2445	91	30	121
2.	1914a	Hodgson	Delhi	110	2	0	2
3.	1921	Christophers and Shortt	India	17	0	2	2
4.	1927	Covell	Bombay, Maharashtra	2445	91	30	121
5.	1927	Challam	Bombay, Maharashtra	151	2	5	7
6.	1928	Covell	Bombay, Maharashtra	671	17	12	29
7.	1929	King and Iyer	Mopad, Madras, Tamil Nadu	166	9	1	10
8.	1930	Banerjee	Lucknow, Uttar Pradesh	75	7	5	12
9.	1931	Sweet and Rao	Mysore, Karnataka	2710	2	0	2
10.	1934	Nursing *et al.*	Mysore, Karnataka	277	3	0	3
11.	1938	Afridi *et al.*	Kutch State, Gujarat	238	2	4	6
12.	1938	Roy *et al.*	Madras Prov., Tamil Nadu	166	–	9	9
13.	1941	Rao	Bihar Prov., Bihar	423	5	7	12
14.	1943	Singh and Jacob	Ahmedabad, Gujarat	155	0	2	2
15.	1943	Senior White and Rao	Madras Prov., Tamil Nadu	151	6	4	10
16.	1943	Senior White and Rao	Vizagapatnam, Andhra Pradesh	225	6	4	10
17.	1945	Subbarao and Apparao	Madras Prov., Tamil Nadu	692	1	11	12
18.	1946	Siddons	Calcutta, West Bengal	1730	4	6	10
19.	1946	Bhaskar Rao *et al.*	Bellay, Karnataka	902	1	1	2
20.	1948	Godbole *et al.*	Bijapur, Karnataka	1706	0	1	1
21.	1950	Viswanathan	Maharashtra	4706	0	1	1
22.	1950	Viswanathan	Bijapur, Karnataka	1272	0	1	1
23.	1962	Neogy and Sen	Durgapur Steel Plant, West Bengal	1613	0	1	1
24.	1962	Neogy and Sen	Burdwan, West Bengal	193	0	1	1
25.	1967	Nair and Samnotra	Broach town, Gujarat	87	0	2	2
26.	1977	Pattanayak *et al.*	Delhi, Union Territory	225	0	1	1
27.	1979	Das *et al.*	Salem, Tamil Nadu	145	2	1	3
28.	1980	Hati and Mukhopadhyay	Calcutta, West Bengal	NM	0	2.5%	2.5%
29.	1982	Sharma *et al.*	Alwar, Rajasthan	170	0	1	1
30.	1983	Annual Report, MRC	Arthala, Uttar Pradesh	119	0	1	1
31.	1983–84	Annual Report, MRC	Delhi, Union Territory	131	0	1	1
32.	1983	Choudhury	Delhi, Union Territory	866	0	1	1
33.	1984–85	Annual Report, MRC	Delhi, Union Territory	2165	0	1	1
34.	1985–86	Annual Report, MRC	Delhi, Union Territory	469	0	1	1
35.	1987	Choudhury and Sen	Calcutta, West Bengal	982	0	1	1
36.	1987	Hati *et al.*	Calcutta, West Bengal	104	0	1	1



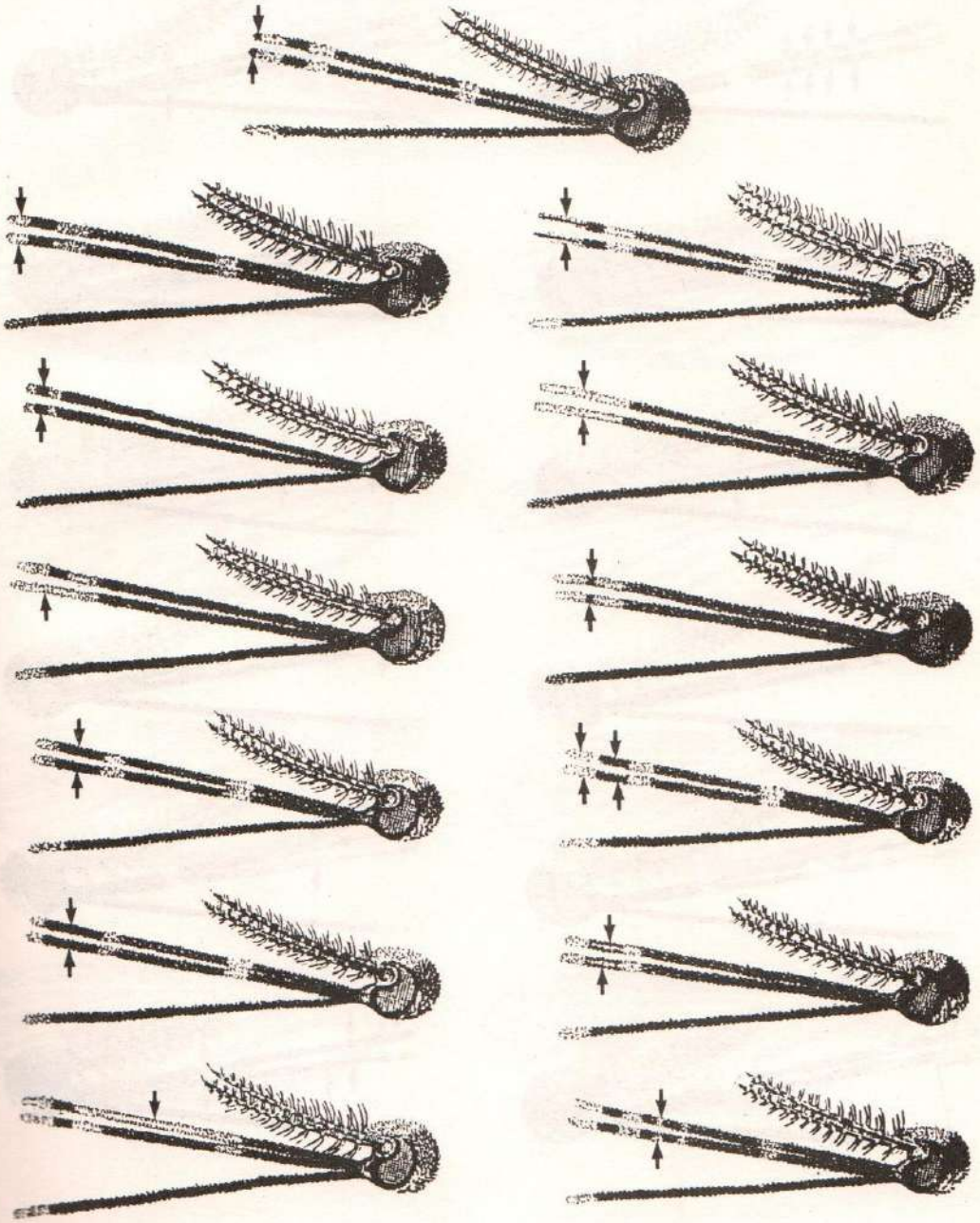
Reported distribution of *An. stephensi* in the World.



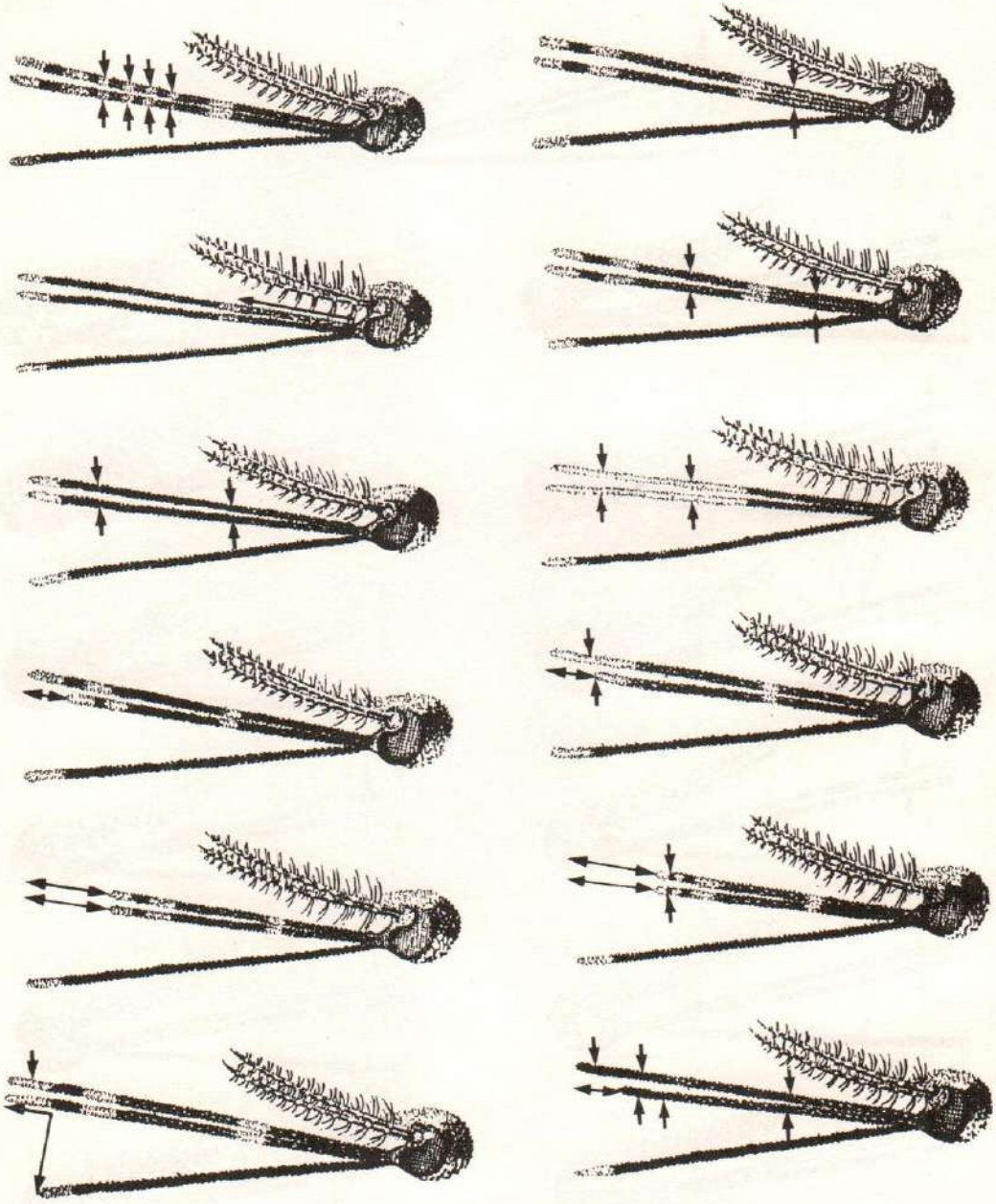
Reported distribution of *An. stephensi* in India.

REPORTED IMPORTANT VARIATIONS OF *An. stephensi*

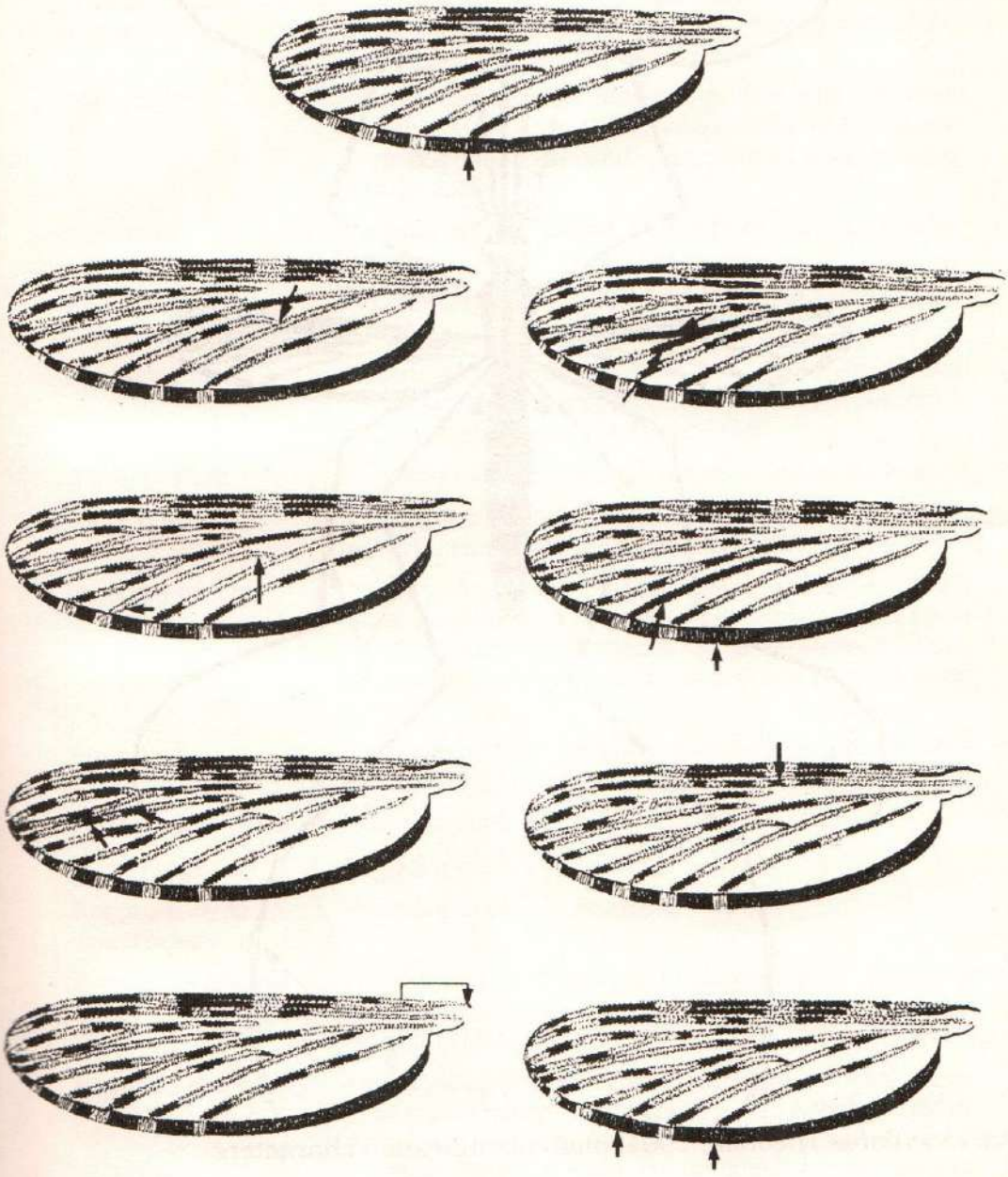
Variations in palpi

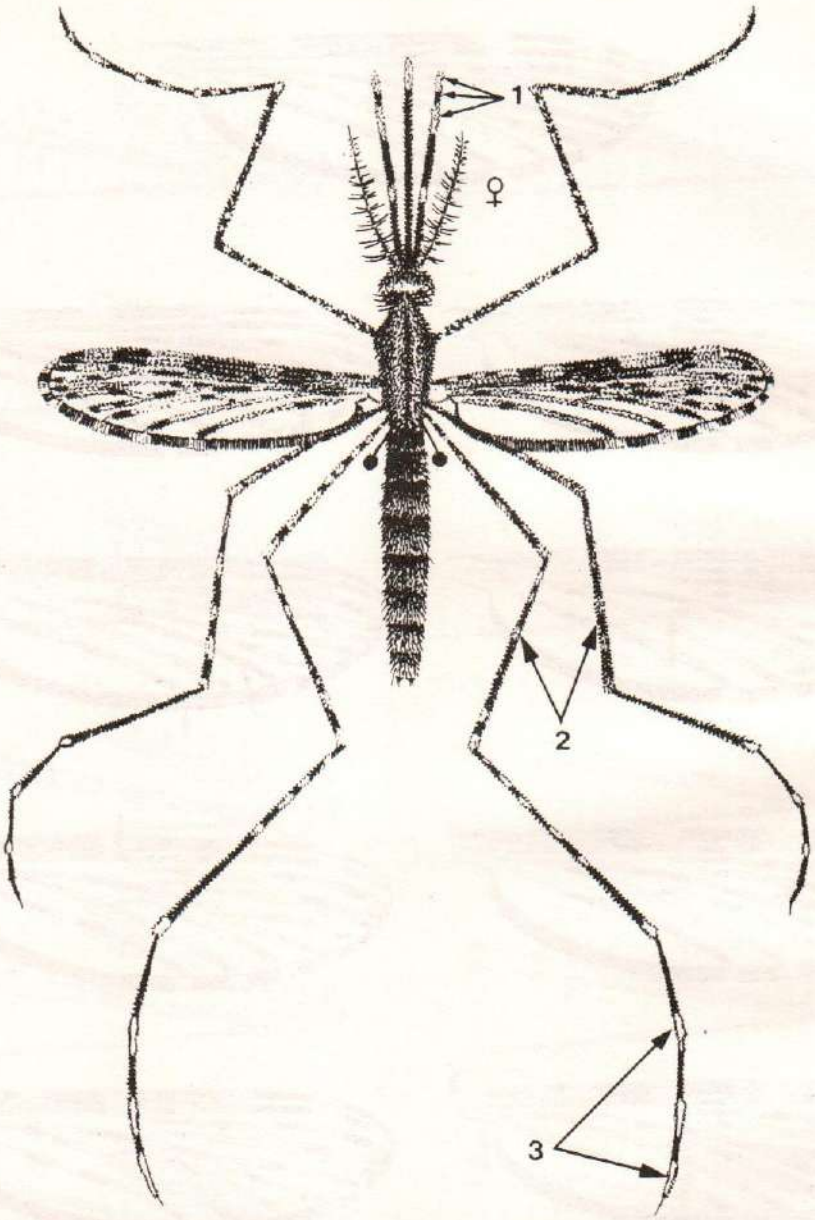


Variations in palpi



Variations in wing





An. maculatus Theobald 1901, main identification characters

1. Apical and subapical pale bands equal and separated by a dark band.
2. Legs with speckling.
3. Hind leg tarsomeres banded as shown in figure

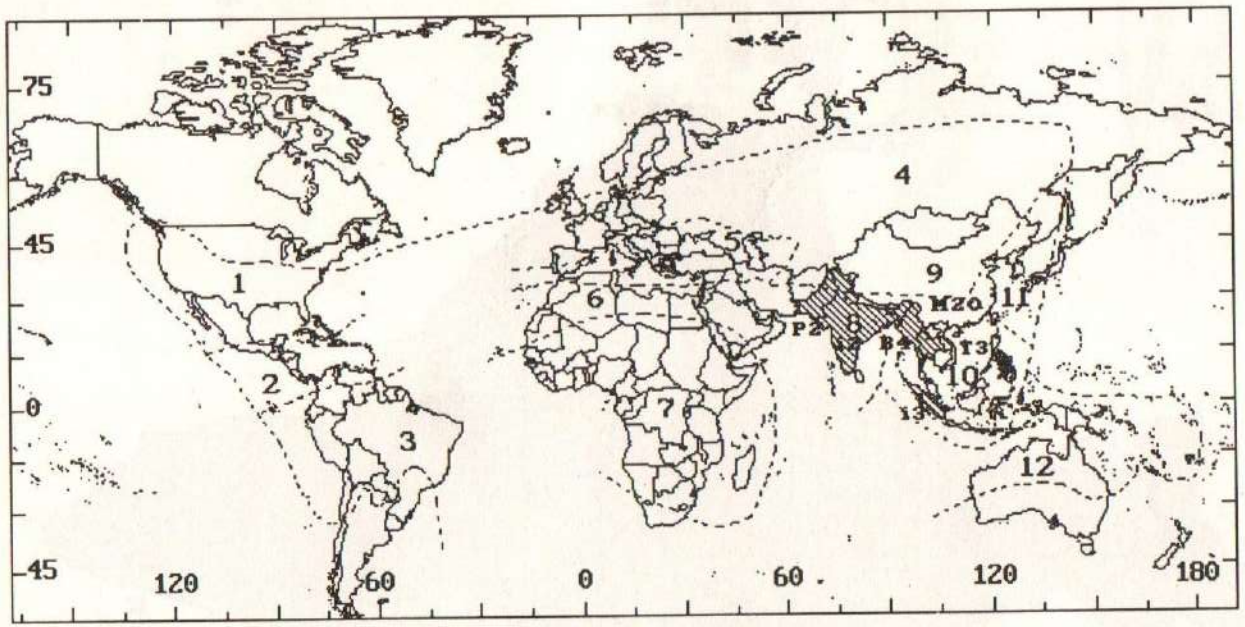
Anopheles maculatus

Name	:	*An. maculatus* Theobald, 1901. *A Monograph of the Culicidae or Mosquitoes,* **1:** 171–174.
Derivative	:	Although described as *maculata* by Theobald, it is listed as *maculatus* in Knight and Stone catalog 1977. In Latin, *maculatus* means spotted, (*maculare* to spot, to stain; *macula*, spot).
Type form	:	Available at the British Museum of Natural History, London.
Reported morphological variations	:	4 in maxillary palpi, 2 in wing and 1 in leg
Species complex	:	Six species (*An. maculatus, An. pseudowillmori, An. willmorei, An. sawadwongporni, An. notanandai, An. dravidieus;* Rattanarithikul and Green, 1986).
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Adults generally rest outdoors in forest areas but also rest in human dwellings and cattlesheds.
Breeding ecology	:	Primarily a stream breeder, also breeds in ponds, tanks, ricefields and riverbed pools. Prefers bright sunlit breeding places and shade has a deleterious effect. Breeding is more pronounced in pre- and post-monsoon months.
Biting time	:	Biting commences soon after dusk and the peak reaches between 21.00 and 24.00 hrs, both outdoors and indoors.
Feeding preference	:	Man and cattle, but prefers cattle.
Flight range	:	Up to 2.2 km.
Susceptibility to insecticides	:	Resistant to DDT in Arunachal Pradesh.
Relation to disease	:	Role in malaria transmission suspected in foothills of northeastern states of India. Very important vector of malaria in Malaysia.
Reported distribution	:	Found widely from Pakistan to Indonesia. In India, occurs in all foothill regions of the country, viz., Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, and West Bengal. Also occurs in Andaman & Nicobar Islands.
Vector incrimination	:	Results of studies made so far are summarized in the table.

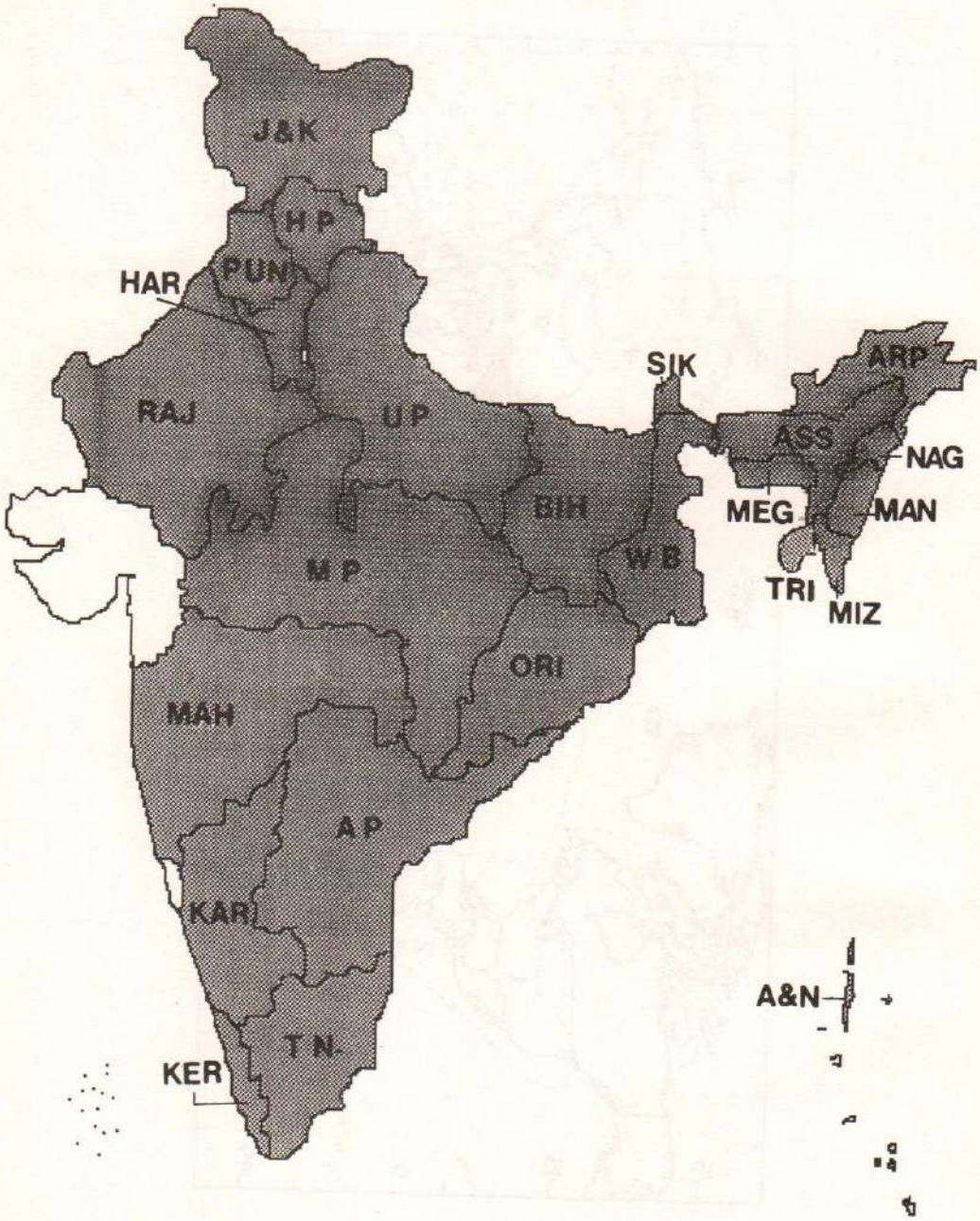
Table : *Anopheles maculatus*: Results of vector incrimination studies

Sl. No.	Year	Author	Locality	Number dissected	Number Positive		
					Gut	Gland	Total
1.	1927	Covell	India	24	7	4	11
2.	1941	Anderson & Viswanathan	Assam	8483	24	5	29
3.	1941	Viswanathan *et al.*	Assam	1573	13	1	14
4.	1990	Kulkarni	Bastar, Madhya Pradesh	NM	0	1	1

NM — Not Mentioned



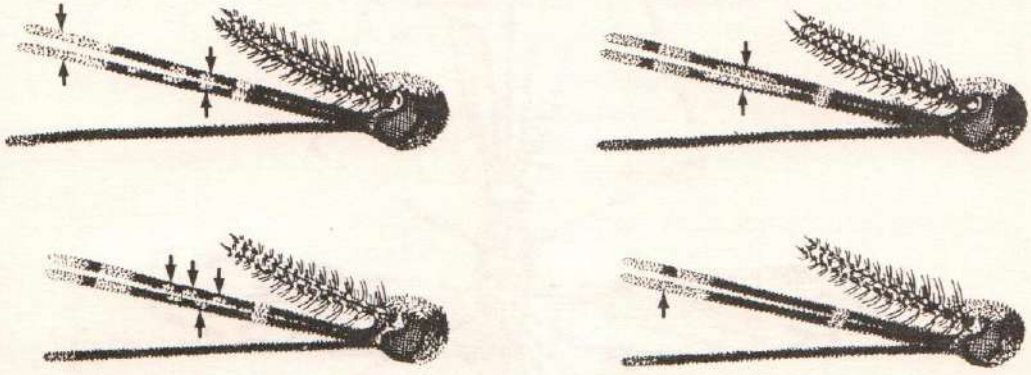
Reported distribution of *An. maculatus* in the World.



Reported distribution of *An. maculatus* in India.

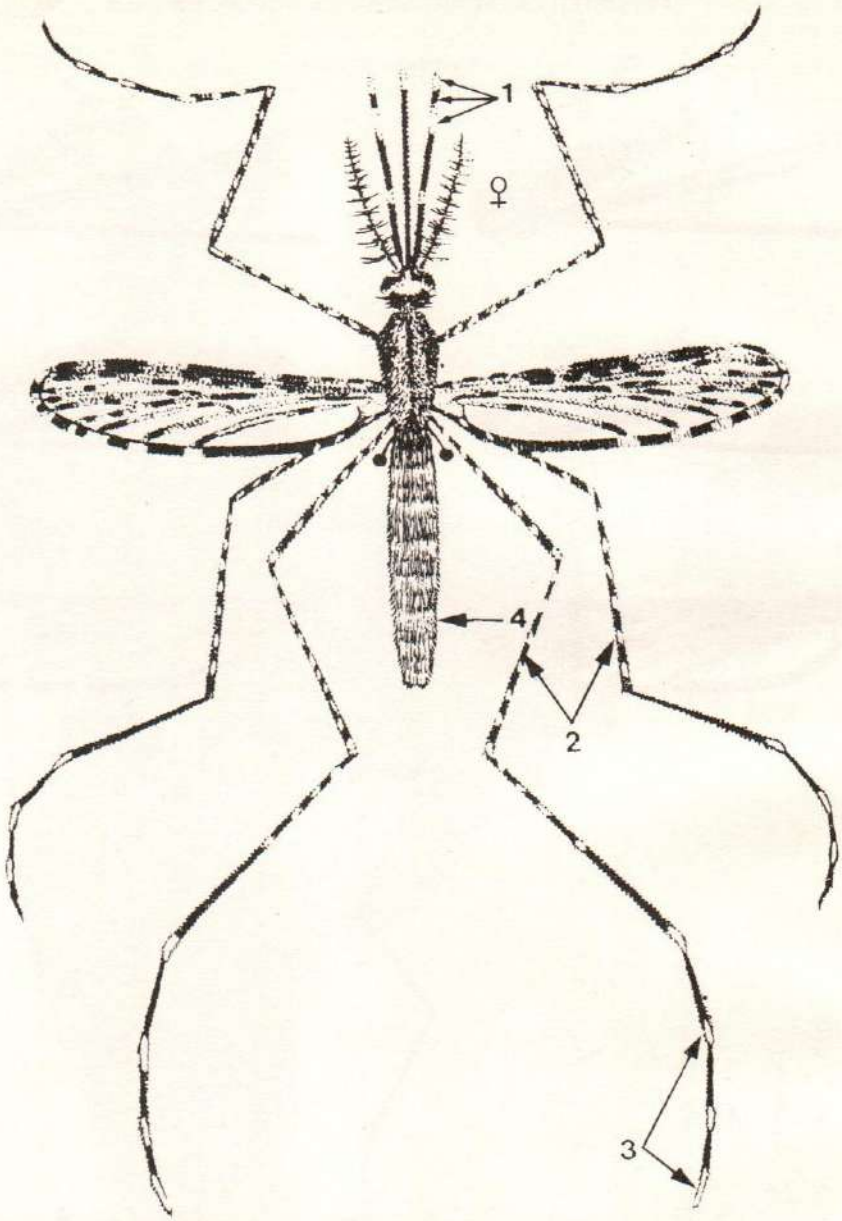
REPORTED IMPORTANT VARIATIONS OF *An. maculatus*

Variations in palpi



Variations in wing

Variation in leg

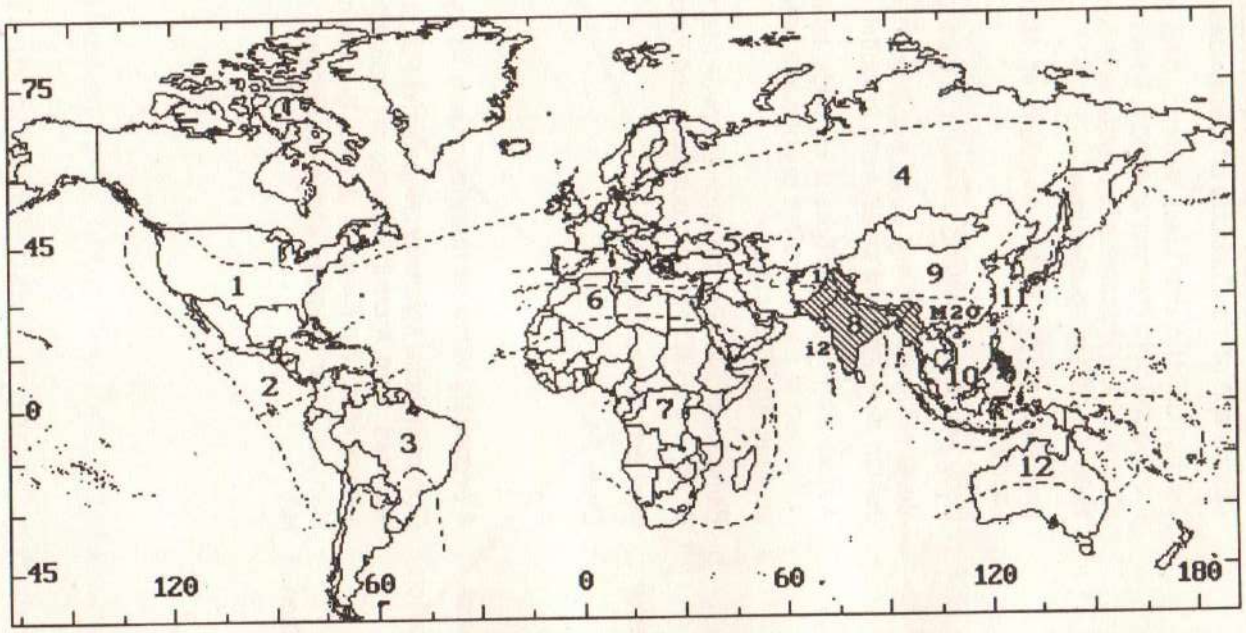


An. willmori (James) 1903, main identification characters

1. Apical and subapical pale bands equal and separated by a dark band.
2. Legs with speckling.
3. Hind leg tarsomeres banded as shown in figure
4. Abdomen covered with golden scales.

Anopheles willmori

Name	:	*An. willmori* (James), 1903. In: Theobald, 1903. *A Monograph of the Culicidae or Mosquitoes,* **3:** 100.
Derivative	:	James named it after Lieut. Willmori, IMS, who collected the species from Kashmir at 4800 ft. Previously it was the variety of *An. maculatus* but Rattanarithikul and Green, 1986 raised it to species level.
Type form	:	Available at the British Museum of Natural History, London.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Rests outdoors in forest areas but also prefers to rest in human dwellings and cattlesheds in foothill areas.
Breeding ecology	:	A stream breeder, also breeds in ponds, tanks, and pools in the bed of rivers. Prefers bright sunlit breeding places as does *An. maculatus.*
Biting time	:	Biting starts just after the dusk and peak reaches between 21.00 and 24.00 hrs both outdoors and indoors.
Feeding preference	:	Man and cattle both.
Flight range	:	Up to 2 km.
Susceptibility to insecticides	:	NA
Relation to disease	:	A secondary vector of malaria in Gum Valley of Nepal.
Reported distribution	:	Occurs in India, Myanmar, Nepal, and Pakistan. In India, recorded from foothill districts of Arunachal Pradesh, Assam, Himachal Pradesh, Jammu & Kashmir, Mizoram, Manipur, Uttar Pradesh, and West Bengal.
Vector incrimination	:	NA



Reported distribution of *An. willmori* in the World.

ARUNACHAL PRADESH (ARP)
1. Subansiri
2. East Kameng

ASSAM (ASS)
1. Kamrup
2. Tejpur

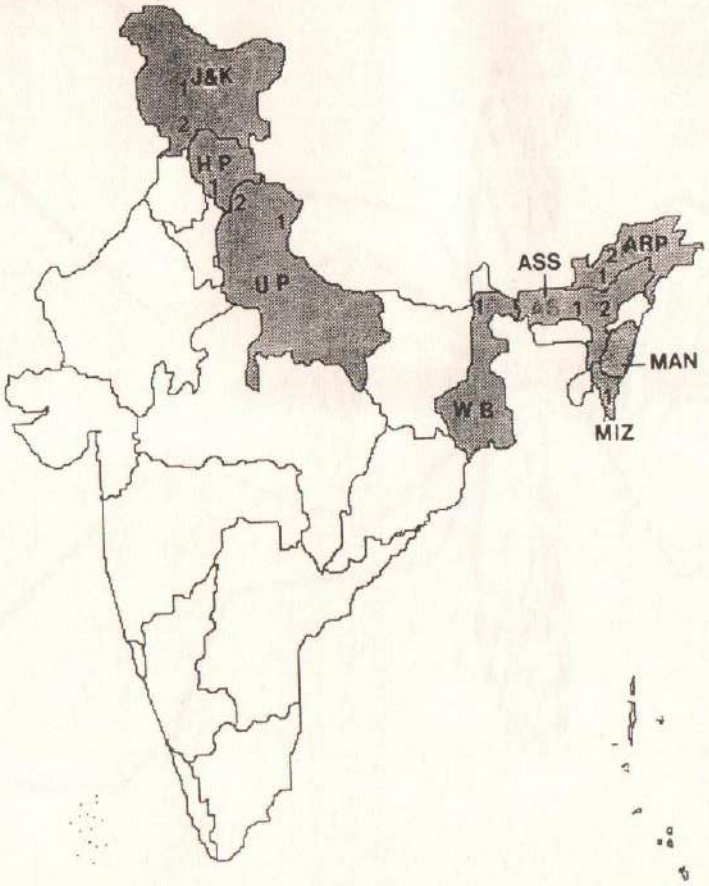
HIMACHAL PRADESH (HP)
1. Solan

JAMMU & KASHMIR (J & K)
1. Srinagar
2. Jammu

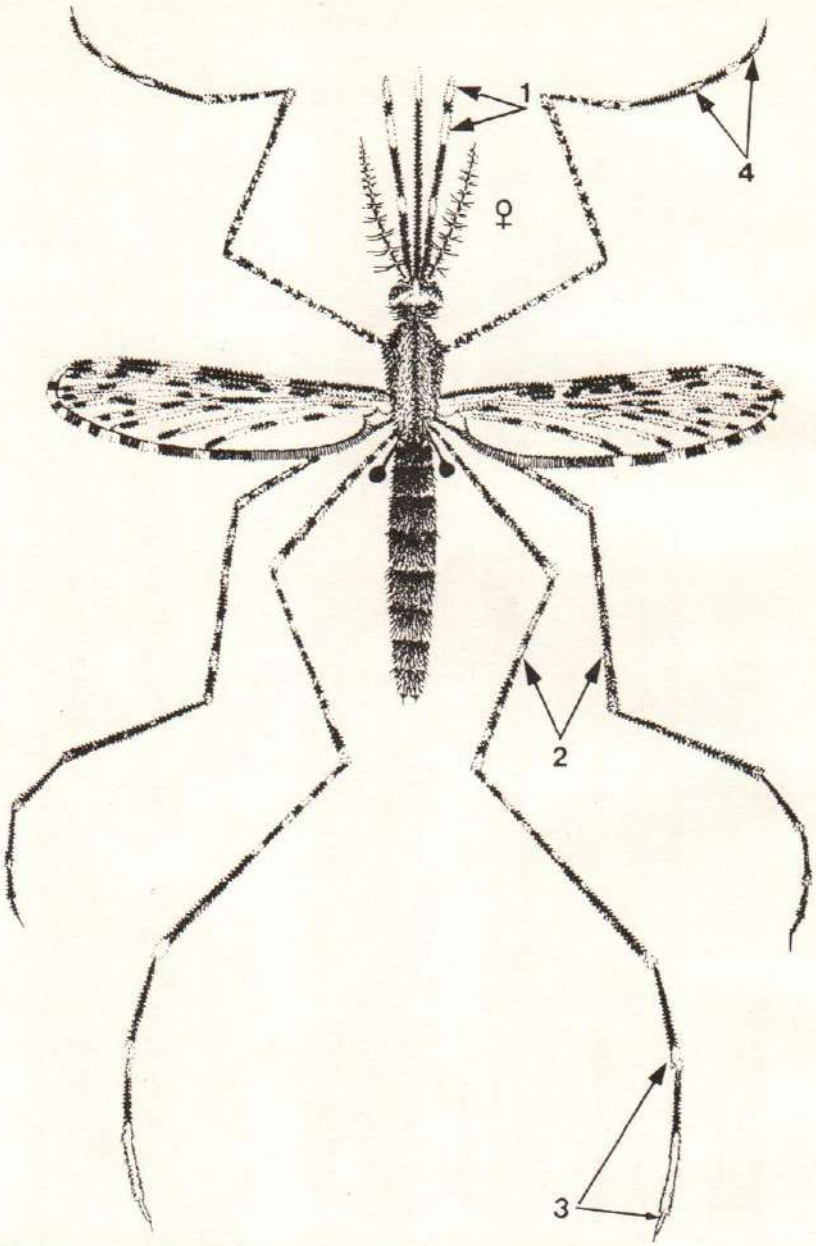
MIZORAM (MIZ)
1. Aizwal

UTTAR PRADESH (UP)
1. Nainital
2. Dehra Dun

WEST BENGAL (WB)
1. Darjeeling



Reported distribution of *An. willmori* in India.

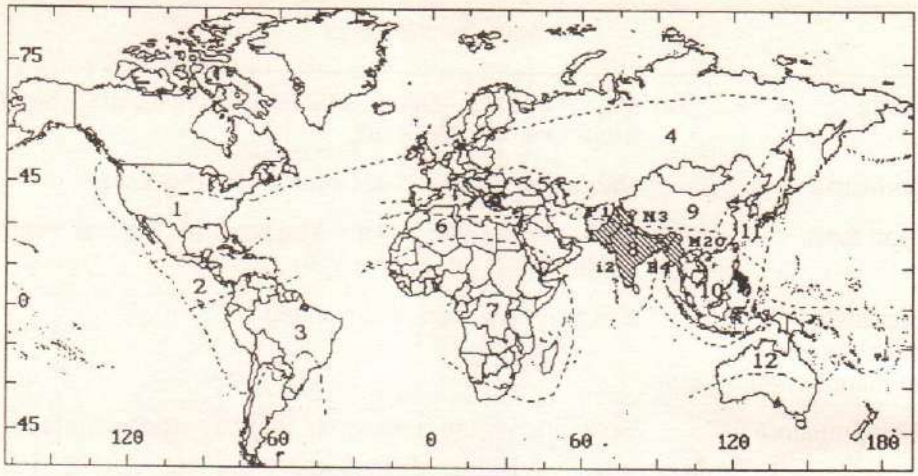


An. theobaldi Giles 1901, main identification characters

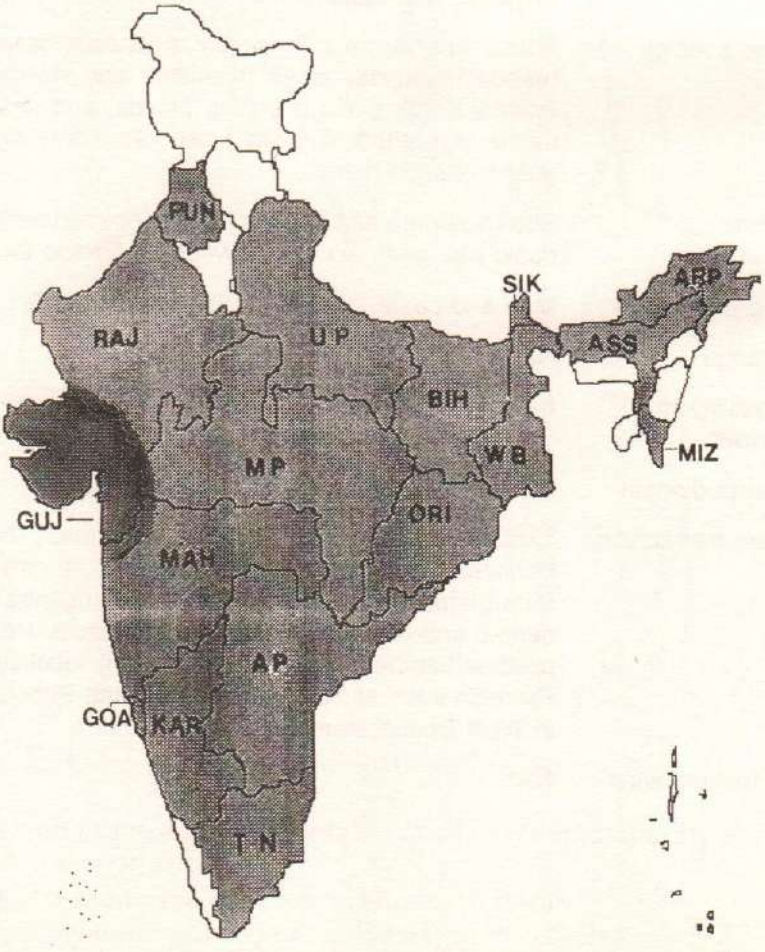
1. Apical and subapical pale bands equal and separated by a dark band.
2. Legs with speckling
3. Hind leg tarsomeres banded as shown in figure
4. Fore leg tarsomeres with broad bands

Anopheles theobaldi

Name	:	*An. theobaldi* Giles, 1901. *Entomologist's Monthly Magazine*, **37:** 196–198.
Derivative	:	Named by Giles in 1901 after F. V. Theobald.
Type form	:	Available at the British Museum of Natural History, London.
Reported morphological variations	:	2 in maxillary palpi and 1 in leg
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Adults generally rest outdoors but also rest in human dwellings and cattlesheds.
Breeding ecology	:	Forest species and basically a stream breeder, also breeds in ponds, tanks, ricefields and riverbed pools. Prefers bright sunlit breeding places, and shade has a deleterious effect. Breeds more commonly in pre- and post-monsoon months.
Biting time	:	Bites outdoors and indoors, biting commences soon after dusk, with peak activity between 21.00 and 24.00 hrs.
Feeding preference	:	Man and cattle, but prefers to feed on cattle.
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	So far no evidence in malaria transmission.
Reported distribution	:	Occurs in Bangladesh, India, Myanmar, Nepal and Pakistan. In India, found scattered in many areas throughout the country, but mainly concentrated in the central and western parts of the Peninsula. Recently this species has been collected from many localities of Uttar Pradesh such as Nainital, Chamoli and Pithoragarh and in West Bengal from Darjeeling district.
Vector Incrimination	:	NA



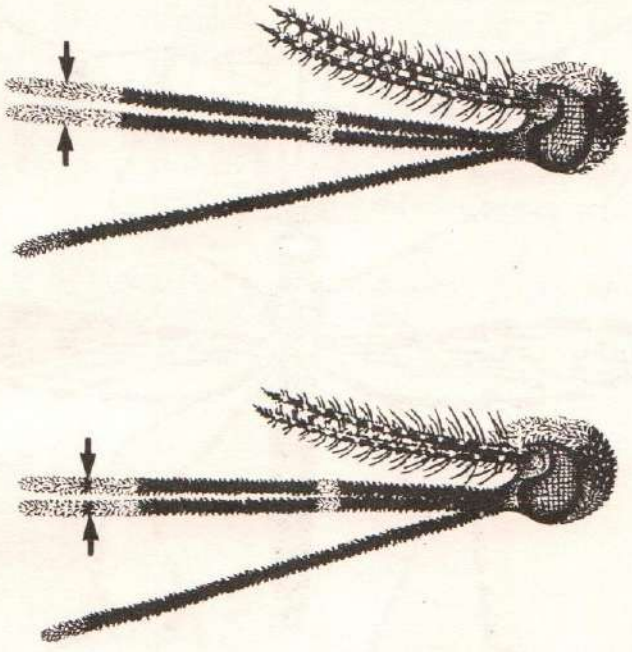
Reported distribution of *An. theobaldi* in the World.



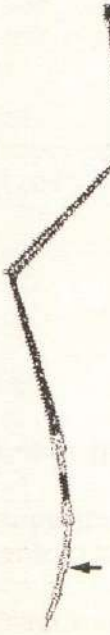
Reported distribution of *An. theobaldi* in India.

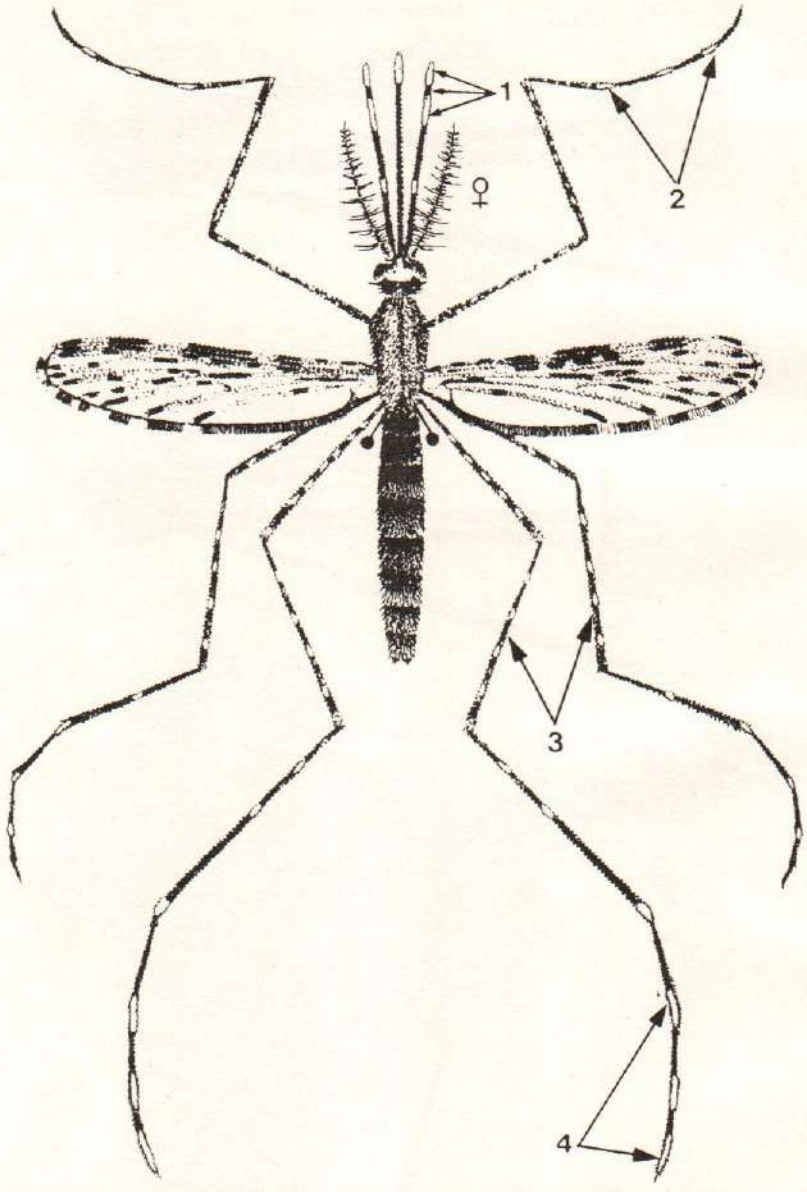
REPORTED IMPORTANT VARIATIONS OF *An. theobaldi*

Variations in palpi



Variation in leg



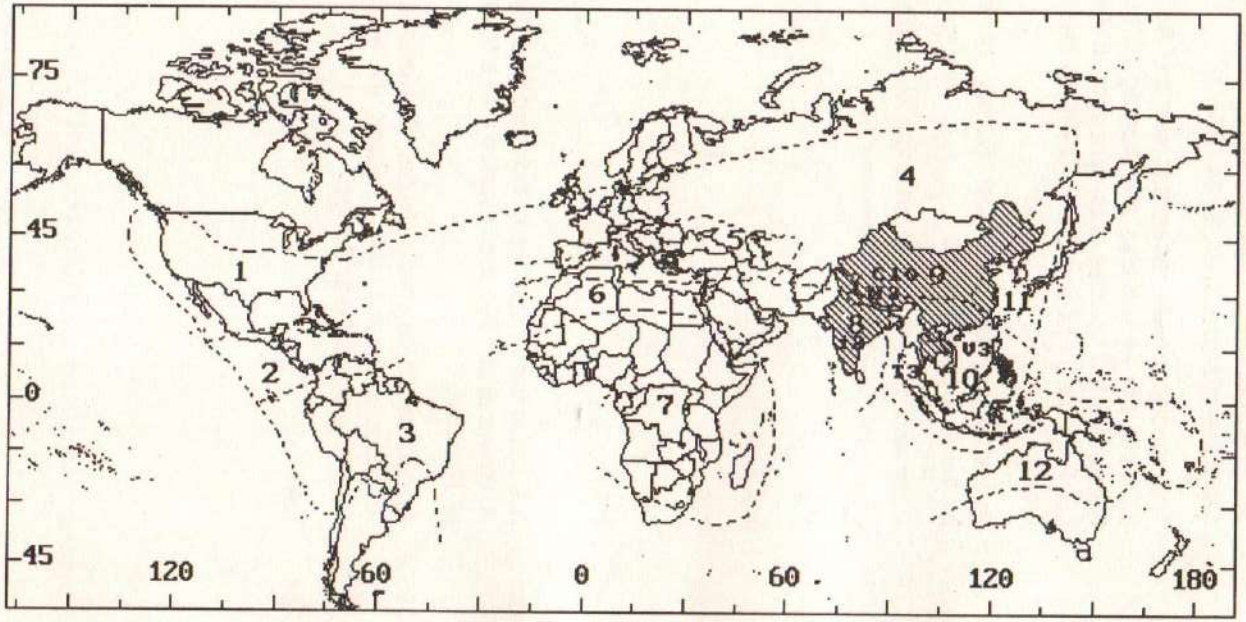


An. pseudowillmori Theobald 1910, main identification characters

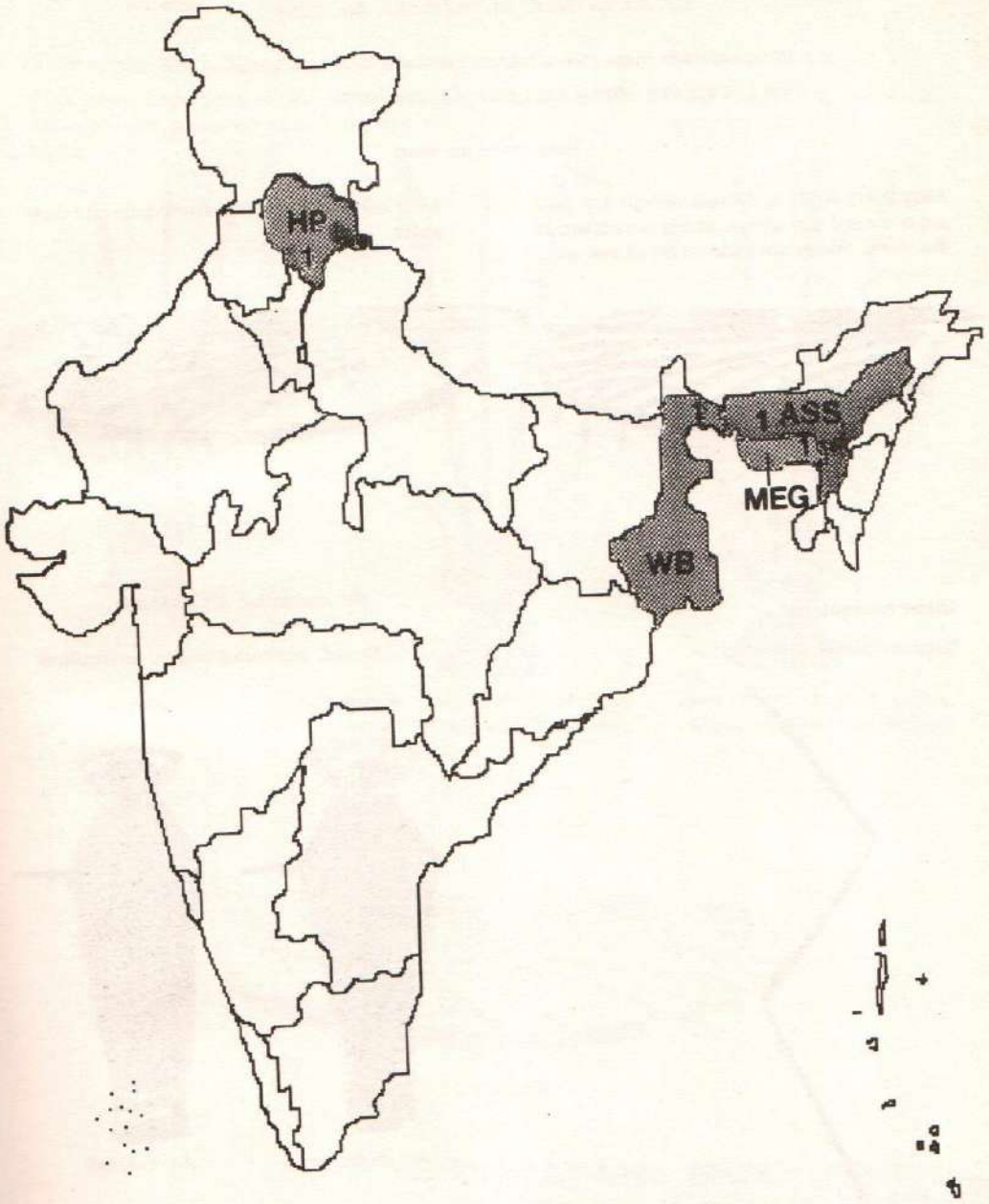
1. Apical and subapical pale bands equal and separated by a dark band
2. Fore leg tarsomeres with broad bands
3. Legs with speckling
4. Hind leg tarsomeres banded as shown in figure

Anopheles pseudowillmori

Name	:	*An. pseudowillmori* Theobald 1910. *A Monograph of the Culicidae or Mosquitoes*, **5:** 65–67.
Derivative	:	The species closely resembles with the *An. willmori* but differs in the wing marks and scaling on the abdomen. Previously the species was synonym of *An. maculatus* but Rattanarithikul and Green, 1986, raised it to species level.
Type form	:	Available at the Zoological Survey of India, Indian Museum, Calcutta, India.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	NA
Breeding ecology	:	NA
Biting time	:	NA
Feeding preference	:	NA
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	It is a non vector species in India but recently Christopher A. Green *et al.* 1991 incriminated it as a Vector of malaria in Thailand.
Reported distribution	:	Occurs in China, India, Nepal, Thailand and Vietnam. In India, recorded from Assam, Himachal Pradesh, Meghalaya and West Bengal.
Vector incrimination	:	NA



Reported distribution of *An. pseudowillmori* in the World.



ASSAM (ASS)
1. Kamrup

HIMACHAL PRADESH (HP)
1. Kasauli

MEGHALAYA (MEG)
1. Shillong

WEST BENGAL (WB)
1. Jalpaiguri

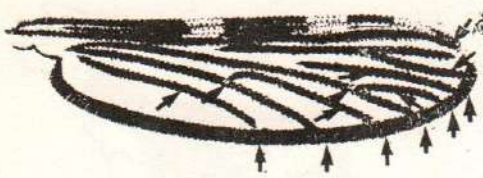
Reported distribution of *An. pseudowillmori* in India.

1.7. An. turkhudi, An. multicolor, An. dthali

Wing with 4 or more pale areas on the costa, subcosta including vein 1(R1)
Tip of palpi dark (Apical band dark with pale hairs)

Pale areas on wing

Wing veins 1(R1) to 6(Anal) without any pale spots except sometimes at the bifurcation of the veins. Fringe spot absent on all the veins



An. dthali

Wing veins 1(R1) to 6(Anal) with pale and dark spots

An. multicolor, An. turkhudi

Other characters

Legs uniformly dark in colour

Broad, scattered scales on scutum

Present

An. multicolor

Absent

An. turkhudi

An. dthali

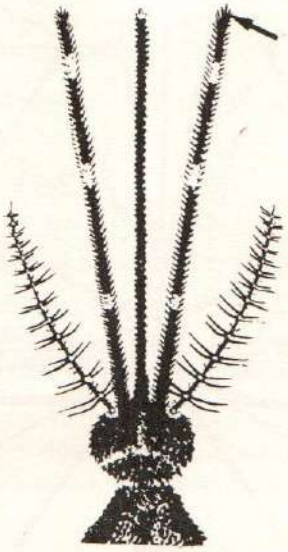
Other characters

Palpi thin and uniform in thickness with two small pale bands

An. multicolor

Other characters

Tip of the palpi has dark tuft of spines

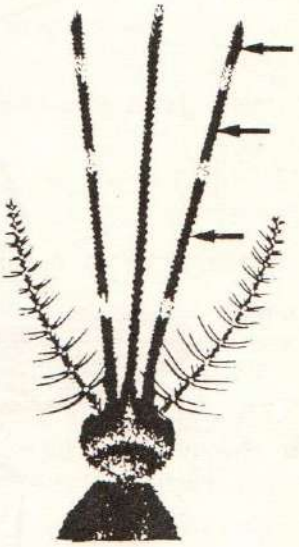


Inner costa somewhat pale, vein 6(Anal) with three dark spots

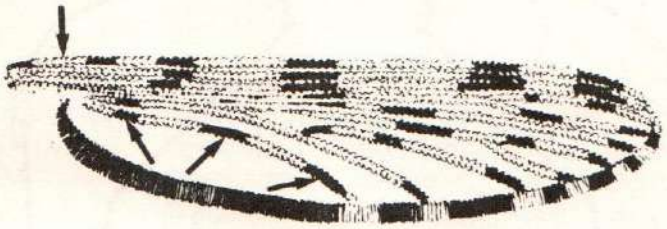
An. turkhudi

Other characters

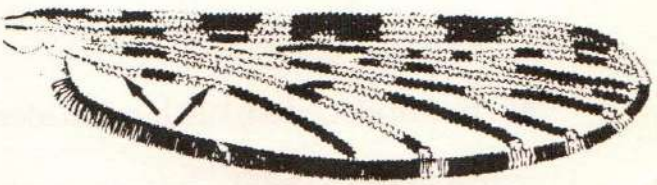
Palpi long, thin, cylindrical, and smooth



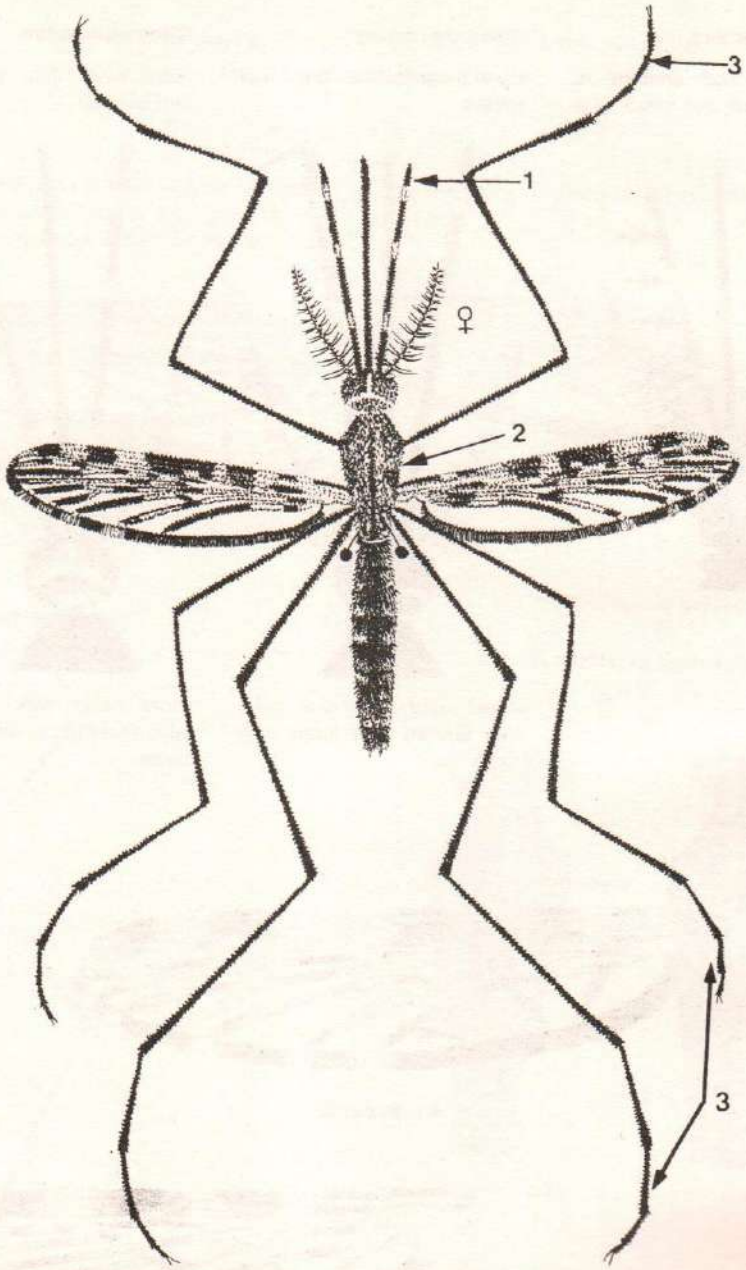
Inner costa dark in colour, wing vein 6(Anal) with two pale spots.



An. multicolor



An. turkhudi



An. turkhudi Liston 1901, main identification characters

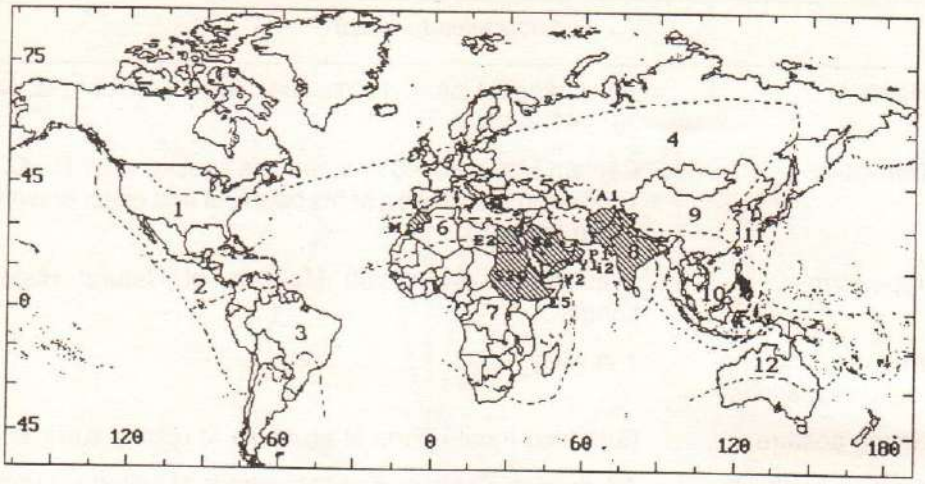
1. Tip of the palpi dark (Apical band dark with pale scales).
2. Mesonotum without broad scales.
3. Tarsomeres without bands

Anopheles turkhudi

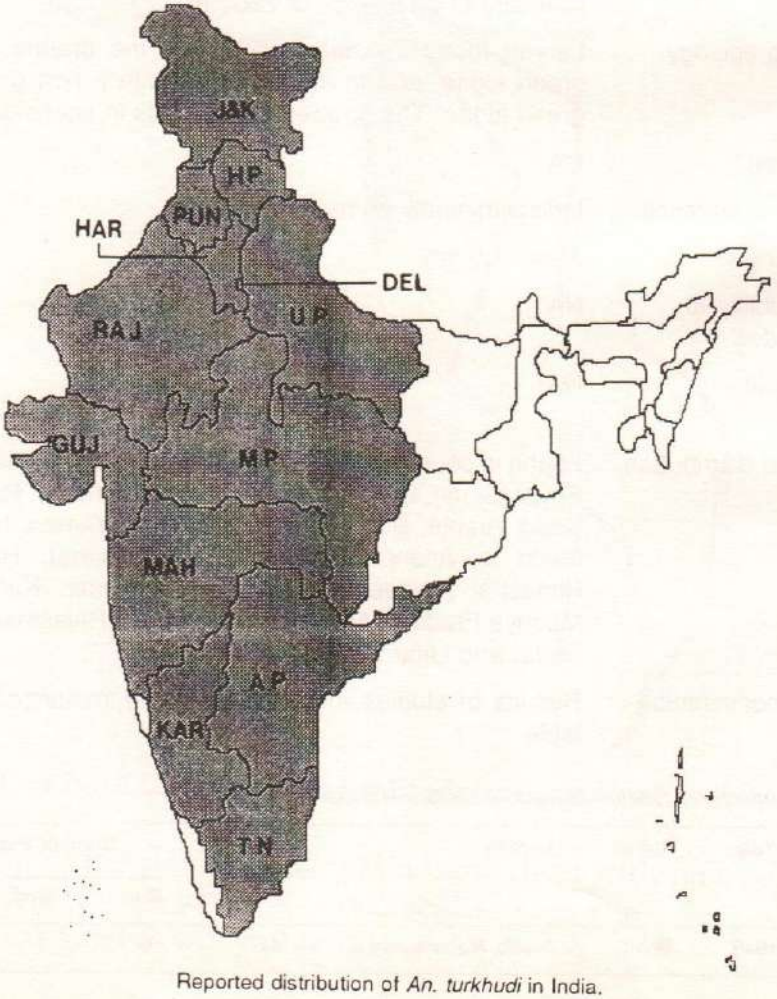
Name	:	*An. turkhudi* Liston, 1901. *The Indian Medical Gazette*, **36:** 441–443.
Derivative	:	Captain Liston in 1901 named this species after Dr. D. A. Turkhud in recognition of his beautiful and exact drawings of the mosquito.
Type form	:	Available at the British Museum of Natural History, London.
Reported morphological variations	:	1 in wing
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Adults rest in houses and cattlesheds at altitudes ranging from 500 to 1,800 m. In Pakistan the species was collected at an altitude of 2800 m.
Breeding ecology	:	Larvae found in shallow pools on the ground among green algae, and in stream pools with a rich growth of green algae. The species also breeds in ricefields.
Biting time	:	NA
Feeding preference	:	Indiscriminately on man and cattle.
Flight range	:	About 1.0 km.
Susceptibility to insecticides	:	NA
Relation to disease	:	NA
Reported distribution	:	Found in countries West of India up to Aden, Afghanistan, Egypt (Sinai), Eritrea, Ethiopia, Israel, Morocco, Pakistan, Saudi Arabia, Somaliland, Sudan, and Yemen. In India, found in Andhra Pradesh, Delhi, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu, and Uttar Pradesh.
Vector incrimination	:	Results of studies made so far are summarized in the table.

Table : *Anopheles turkhudi*: Results of vector incrimination studies

Sl. No.	Year	Author	Locality	Number dissected	Number Positive		
					Gut	Gland	Total
1.	1949	Bhatt	Nasik, Maharashtra	417	0	1	1



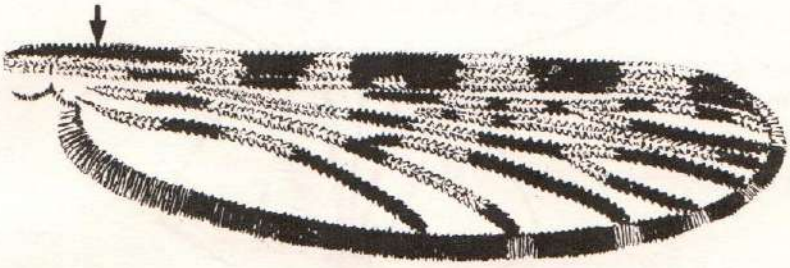
Reported distribution of *An. turkhudi* in the World.

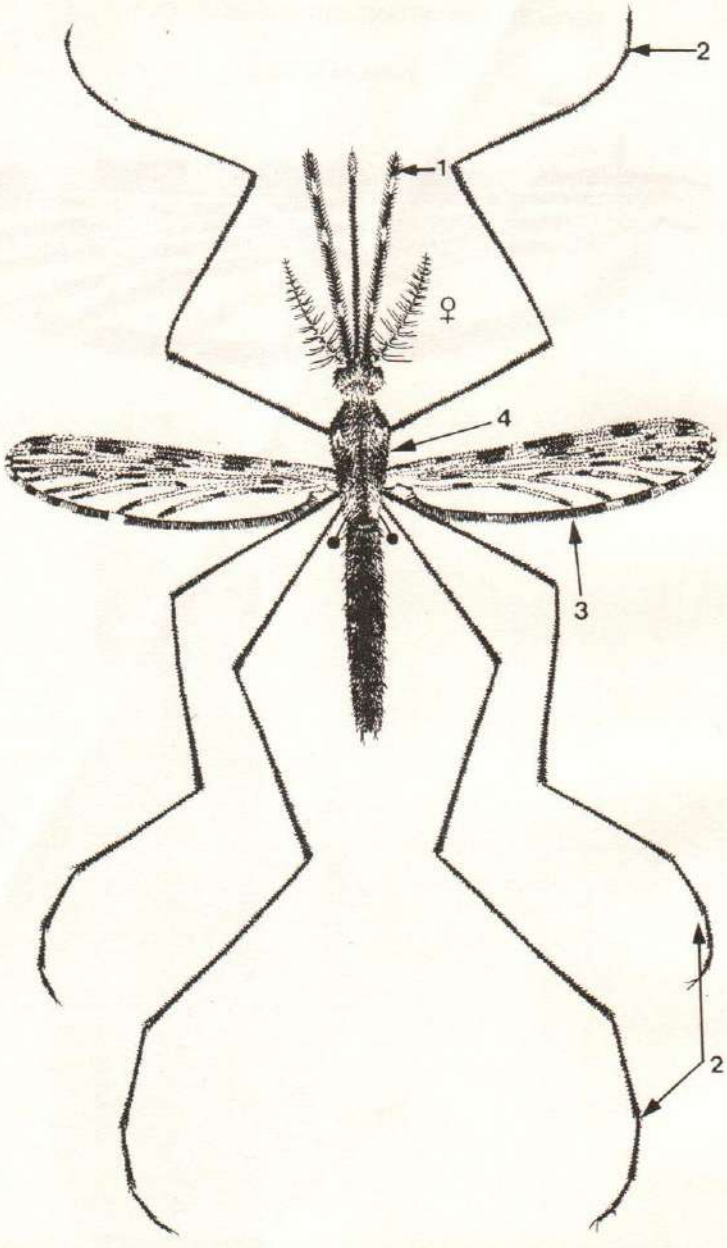


Reported distribution of *An. turkhudi* in India.

REPORTED IMPORTANT VARIATIONS OF *An. turkhudi*

Variation in wing



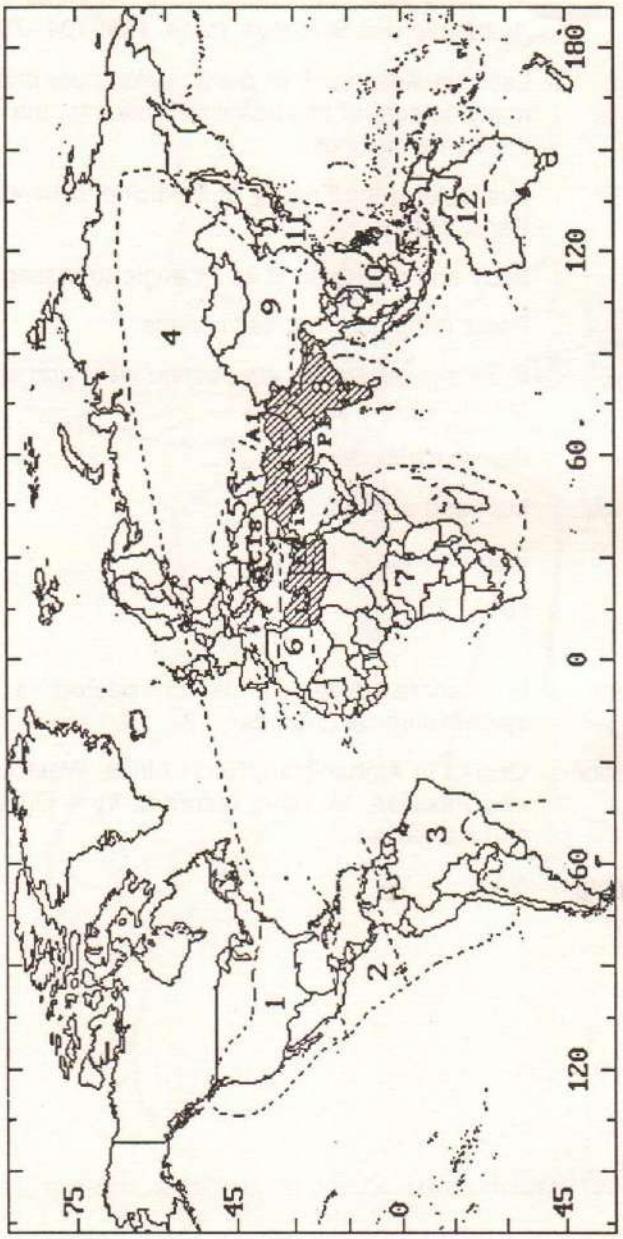


An. multicolor Cambouliu 1902, main identification characters

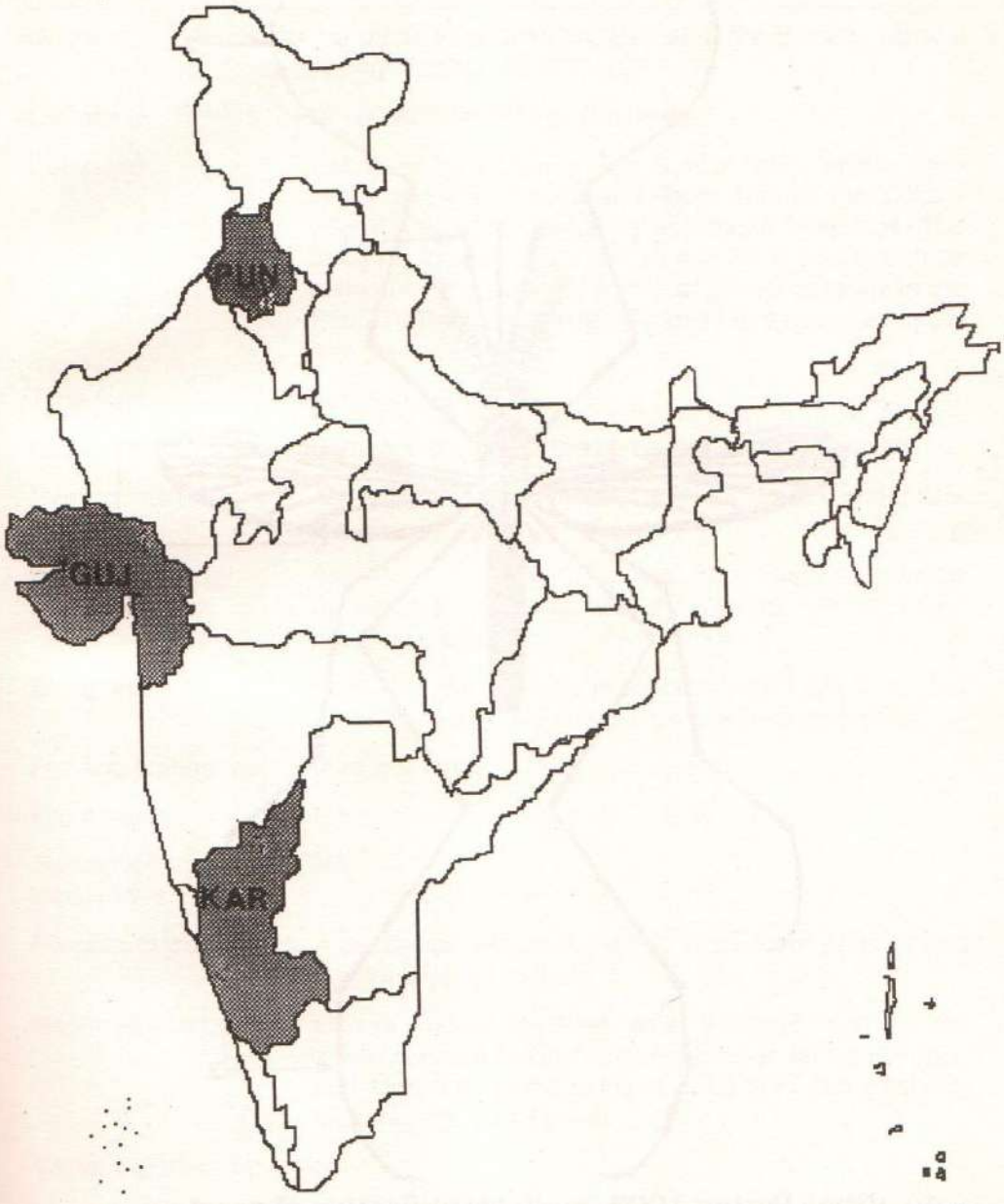
1. Tip of the palpi dark (Apical band dark with pale hairs)
2. Tarsomeres without bands
3. Fringe spot absent on vein 6 (Anal vein)
4. Mesonotum with broad scattered scales

Anopheles multicolor

Name	:	*An. multicolor* Cambouliu, 1902. *Compte Rendu de 1 Academie des Sciences, Paris*, **135:** 704–706.
Derivative	:	Latin, *multus*, much or many; *color*, hue. Impressed with many colours of this beautiful mosquito, the author gave the name *multicolor.*
Type form	:	Available at the Faculty of Medicine, University of Paris, Paris, France.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Rests in houses and cattlesheds.
Breeding ecology	:	Breeds in disused or abandoned wells and can withstand salinity up to 6%.
Biting time	:	Before midnight.
Feeding preference	:	Man and animals.
Flight range	:	Reported up to 13 km.
Susceptibility to insecticides	:	NA
Relation to disease	:	In Sahara desert it is considered a vector on epidemiological grounds.
Reported distribution	:	Occurs in Afghanistan, North Africa, West Asia, Cyprus, and Pakistan. In India, recorded from Gujarat, Punjab, and Karnataka.
Vector incrimination	:	NA



Reported distribution of *An. multicolor* in the World.

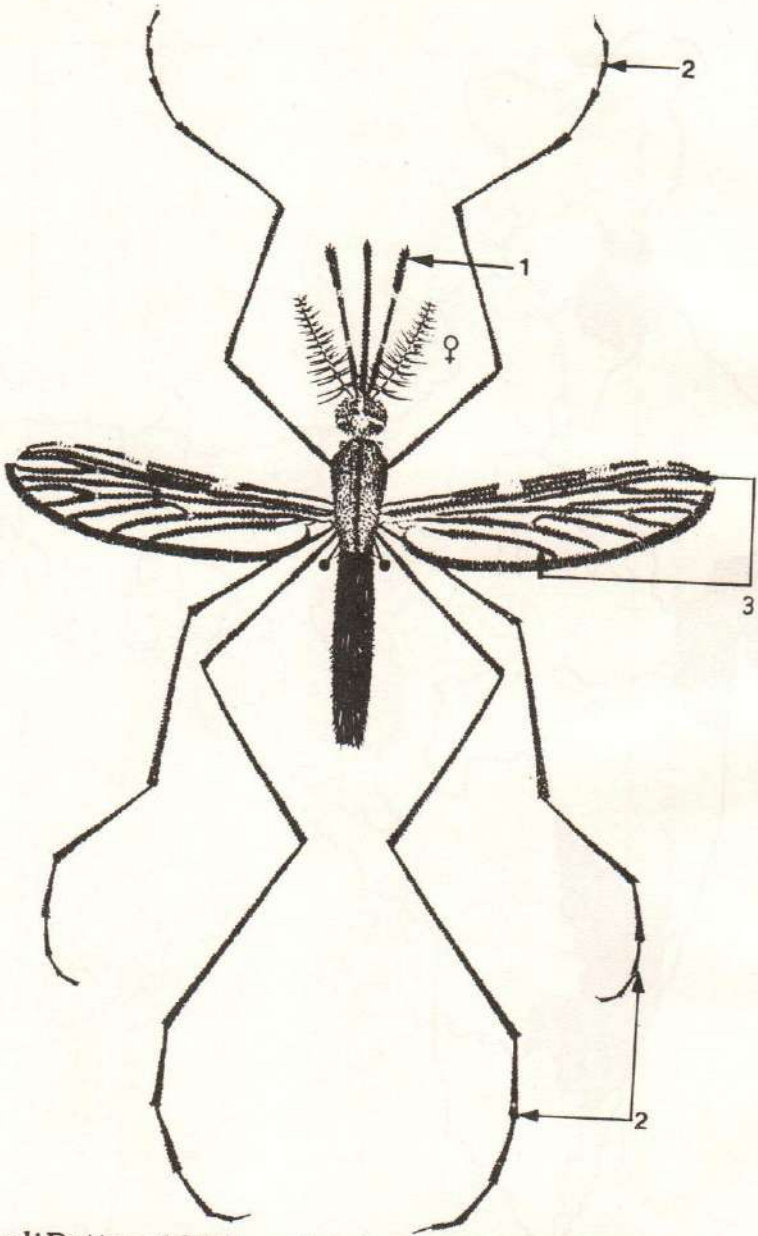


GUJARAT (GUJ)
1. Panchmahal

KARNATAKA (KAR)
1. Bijapur
2. Kanara

PUNJAB (PUN)
1. Patiala

Reported distribution of *An. multicolor* in India.

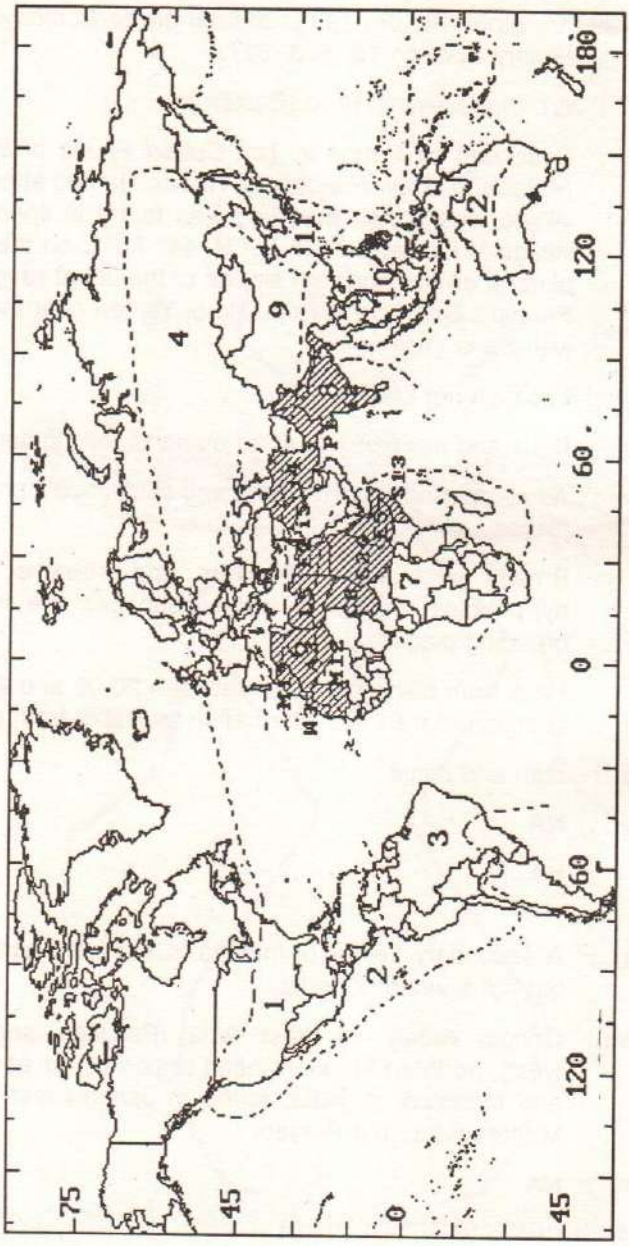


An. dthali Patton 1905, main identification characters

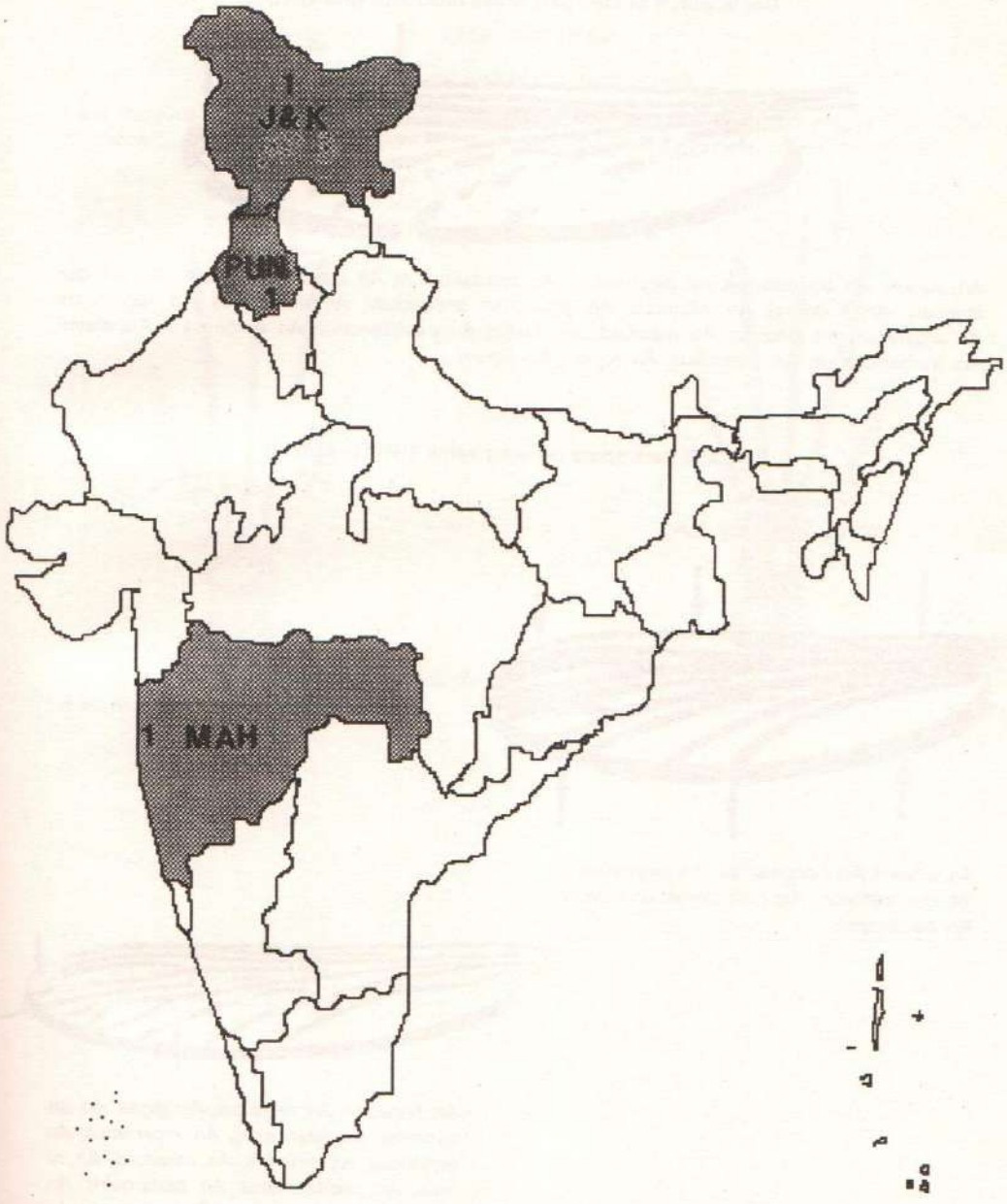
1. Tip of the palpi dark (Apical band dark with pale hairs)
2. Tarsomeres without bands
3. Vein 1 (RI) to 6 (Anal vein) completed dark

Anopheles dthali

Name	:	*An. dthali* Patton, 1905. *Journal of the Bombay Natural History Society*. **16:** 623–627.
Old name	:	*An. rhodesiensis* Theo (Eastern).
Derivative	:	Described by Patton in *The Culicid Fauna of the Aden Hinterland, Their Haunts and Habits*. Named after D'thala village where their breeding was found in springs. The village is located at 13° 45' N, 44° 33' E on the D'thala plateau on the northern slopes of the Jehat range in the People's Democratic Republic of Yemen near the border with Saria (Yemen).
Type form	:	Location not known.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Adults rest indoors in houses and cattlesheds; prefer dark places.
Breeding ecology	:	Breeds in margins of rivers and streams covered by pebbles; ricefields, water seepages are important breeding places.
Biting time	:	Peak man-biting period is between 20.00 and 21.00 hrs in southern Iran. No information available from India.
Feeding preference	:	Man and cattle.
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	A secondary vector of malaria in southern parts of Iran but not a vector in India.
Reported distribution	:	Occurs widely in West Asia (Pakistan and to the west); northern Mediterranean region as far as Ethiopia, and Morocco; in India, found in Jammu and Kashmir, Maharashtra, and Punjab.
Vector incrimination	:	NA



Reported distribution of *An. dthali* in the World.



JAMMU & KASHMIR (J & K)
1. Foothill areas

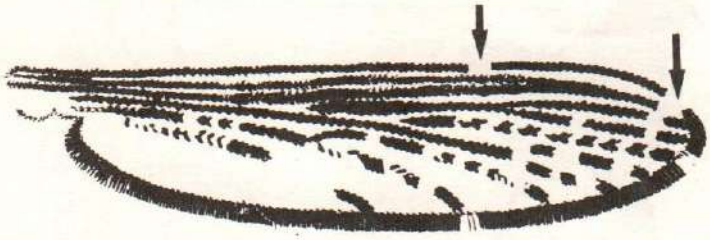
MAHARASHTRA (MAH)
1. Bombay

PUNJAB (PUN)
1. Patiala

Reported distribution of *An. dthali* in India.

2. Subgenus Anopheles

Costa with 3 or less pale areas including vein 1(R1)



An. aitkenii, An. bengalensis, An. pinjaurensis, An. insulaeflorum, An. culiciformis, An. sintoni, An. barianensis, An. lindesayi, An. nilgiricus, An. gigas, An. annandalei, An. interruptus, An. nigerrimus, An. argyropus, An. sinensis, An. crawfordi, An. nitidus, An. peditaeniatus, An. barbirostris, An. ahomi, An. barbumbrosus, An. umbrosus, An. roperi, An. baileyi

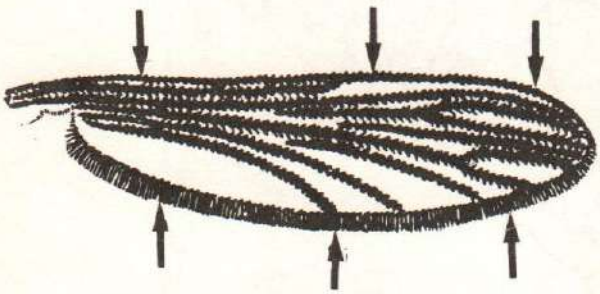
WING

Pale and dark spots on wing veins 1(R1) to 6(Anal)

Absent

(Wing completely dark)

Present



An. aitkenii, An. bengalensis, An. pinjaurensis, An. insulaeflorum, An. culiciformis, An. sintoni, An. barianensis

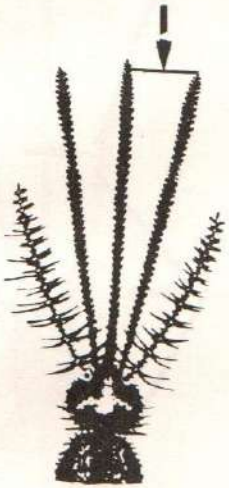
An. lindesayi, An. nilgiricus, An. gigas, An. annandalei, An. interruptus, An. nigerrimus, An. argyropus, An. sinensis, An. crawfordi, An. nitidus, An. peditaeniatus, An. barbirostris, An. ahomi, An. barbumbrosus, An. umbrosus, An. roperi, An. baileyi

An. aitkenii, An. bengalensis, An. pinjaurensis, An. insulaeflorum, An. culiciformis, An. sintoni, An. barianensis

PALPI AND HEAD

Palpi and size of the head scales

Palpi completely dark and equal to the length of proboscis. Head scales small in size



An. aitkenii, An. bengalensis, An. insulaeflorum, An. pinjaurensis, An. barianensis

Palpi completely dark but slightly shorter than the proboscis. Head scales fairly broad

An. culiciformis, An. sintoni

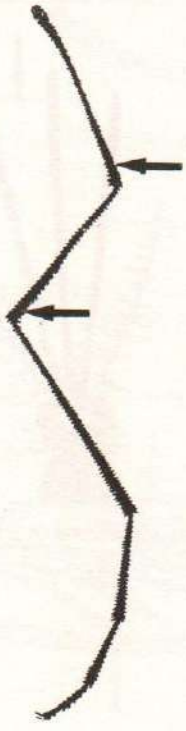
(Sec. 2.1)

An. aitkenii, An. bengalensis, An. insulaeflorum, An. pinjaurensis, An. barianensis

HIND LEG

Pale band towards the end of hind femur and a pale ring on tibia at termination

Absent



An. aitkenii, An. bengalensis, An. insulaeflorum, An. pinjaurensis (Sec. 2.2)

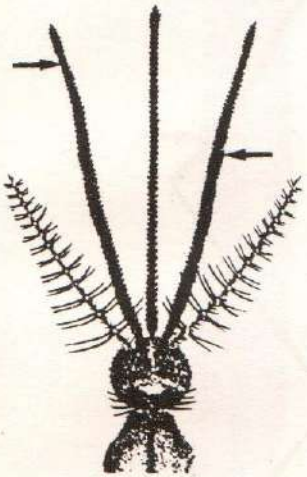
Present

An. barianensis

An. lindesayi, An. nilgiricus, An. gigas, An. baileyi, An. annandalei, An. interruptus, An. nigerrimus, An. argyropus, An. sinensis, An. crawfordi, An. nitidus, An. peditaeniatus, An. barbirostris, An. ahomi, An. barbumbrosus, An. umbrosus, An. roperi

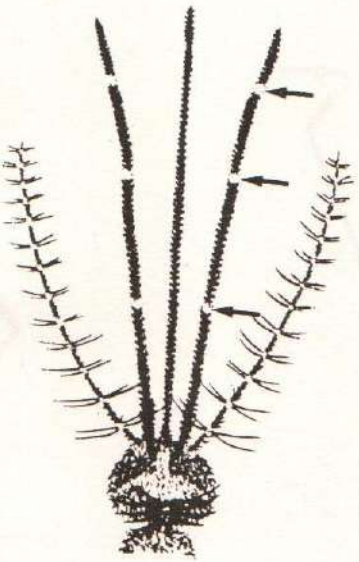
PALPI

Palpi completely dark



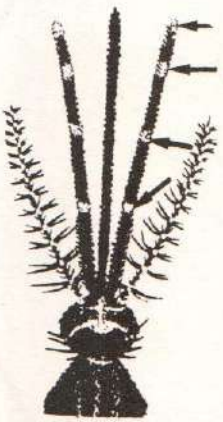
An. barbirostris, An. ahomi, An. barbumbrosus, An. roperi, An. umbrosus, An. lindesayi, An. nilgiricus

Palpi dark but with very small pale bands at the joints



An. gigas, An. baileyi, An. annandalei, An. interruptus,

Tip of the palpi pale (four-banded palpi)



An. nigerrimus, An. nitidus, An. crawfordi, An. sinensis, An. argyropus, An. peditaeniatus, (Sec. 2.4)

An. barbirostris, An. ahomi, An. barbumbrosus, An. roperi, An. umbrosus, An. lindesayi, An. nilgiricus

HIND LEG

Pale area on hind femur

Present

An. lindesayi, An. nilgiricus (Sec. 2.3)

Absent

An. barbirostris, An. umbrosus, An. roperi, An. barbumbrosus, An. ahomi,

An. barbirostris, An. barbumbrosus, An. roperi, An. umbrosus, An. ahomi

ABDOMEN

Tuft of dark scales on the ventral side of 7th abdominal segment

Absent

An. umbrosus, An. roperi

(Sec. 2.5)

Present

An. barbirostris, An. ahomi, An. barbumbrosus

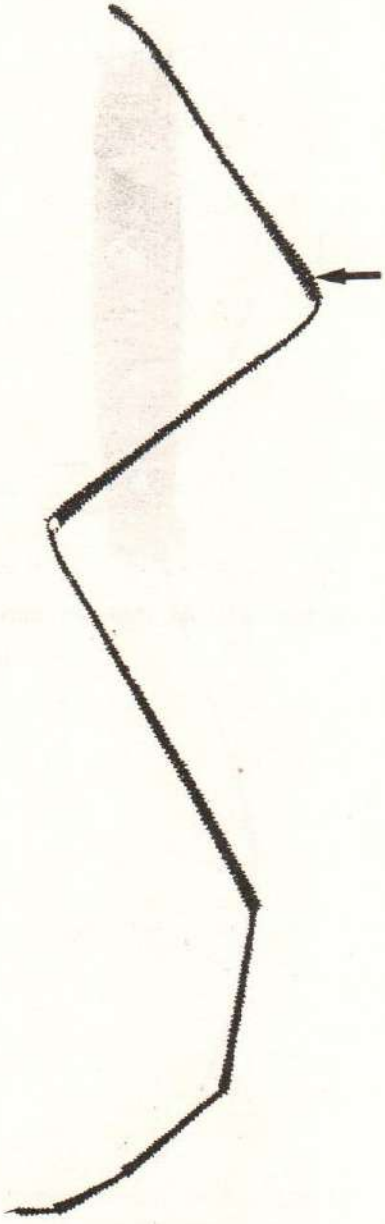
(Sec. 2.6)

An. gigas, An. baileyi, An. annandalei, An. interruptus

HIND LEG

Apex of hind femur with a prominent tuft of white and black scales visible to naked eye

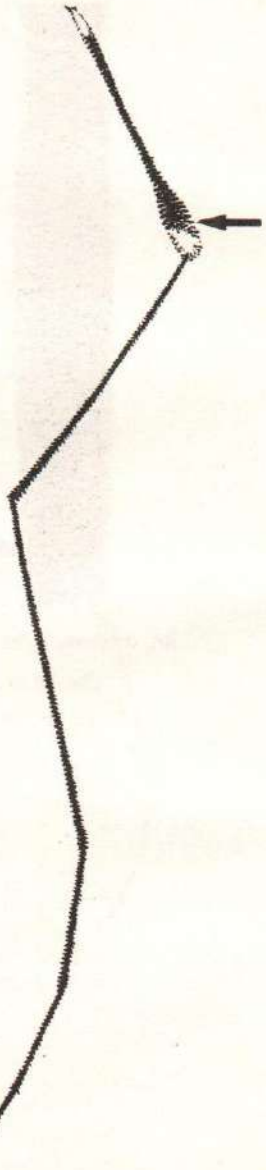
Absent



An. gigas, An. baileyi

(Sec. 2.7)

Present



An. annandalei, An. interruptus

(Sec. 2.8)

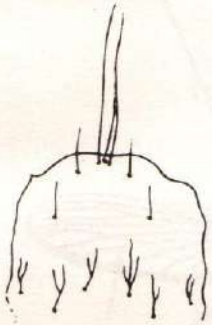
2.1. An. culiciformis, An. sintoni

Wing completely dark

Palpi shorter than proboscis, head scales fairly broad

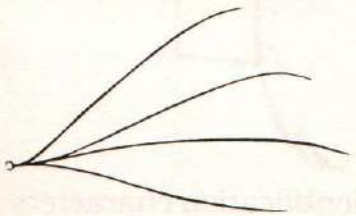
Further identification of these two species is based on larval characters, branches, and shape of frontal (5c, 6c, 7c; clypeal hairs 5, 6, 7) lateral, subantennal (11c; clypeal hair11) and prothoracic (9p to 12p; prothoracic hairs 9, 10, 11, 12) hairs

Frontal hairs (5c, 6c, 7c; clypeal hairs 5, 6, 7) with one or two branches



Subantennal hair (11c; clypeal hair 11) club shaped

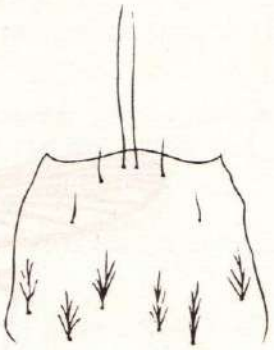
Prothoracic hair (9p to 12p; prothoracic hairs 9, 10, 11, 12) very thin but not spine-like



Lateral hair, long (present on abdominal segment 3 to 6 with very few short branches

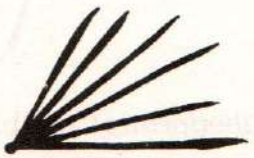
An. culiciformis

Frontal hairs (5c, 6c, 7c; clypeal hairs 5, 6, 7), with more branches (feathered)



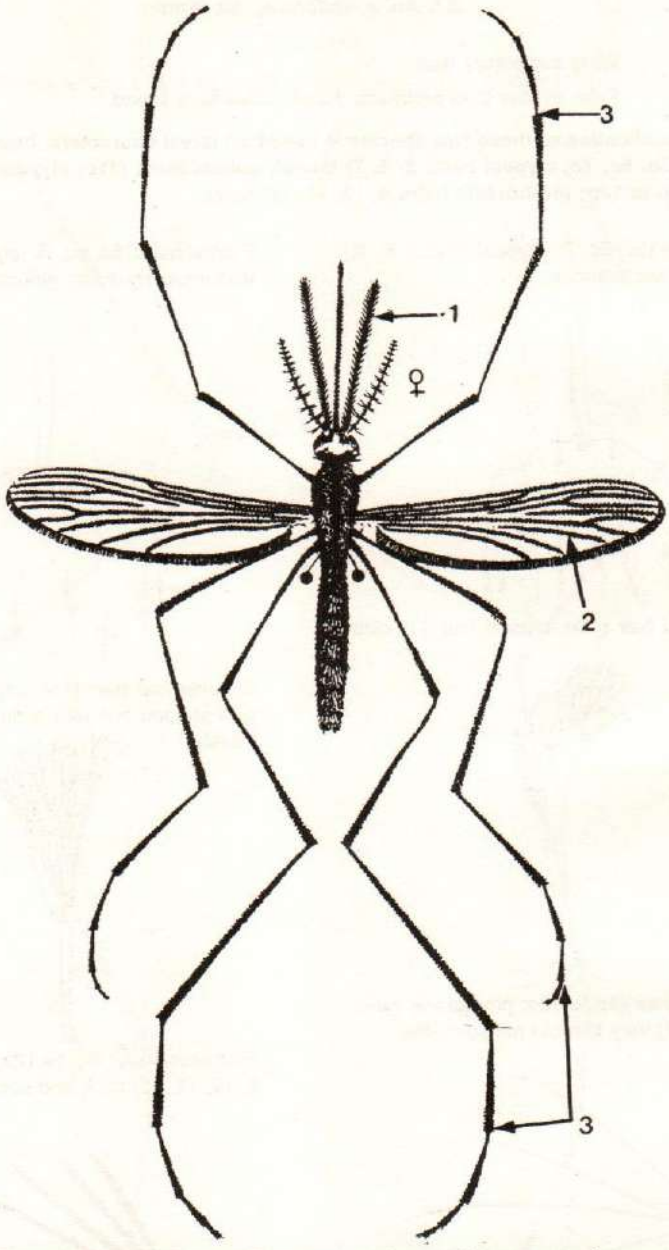
Subantennal hair (11c; clypeal hair 11) not club shaped but with a number of branches distally

Prothoracic hair (9p to 12p; prothoracic hairs 9, 10, 11, 12) thick and spine-like



Lateral hair, with very long branches

An. sintoni



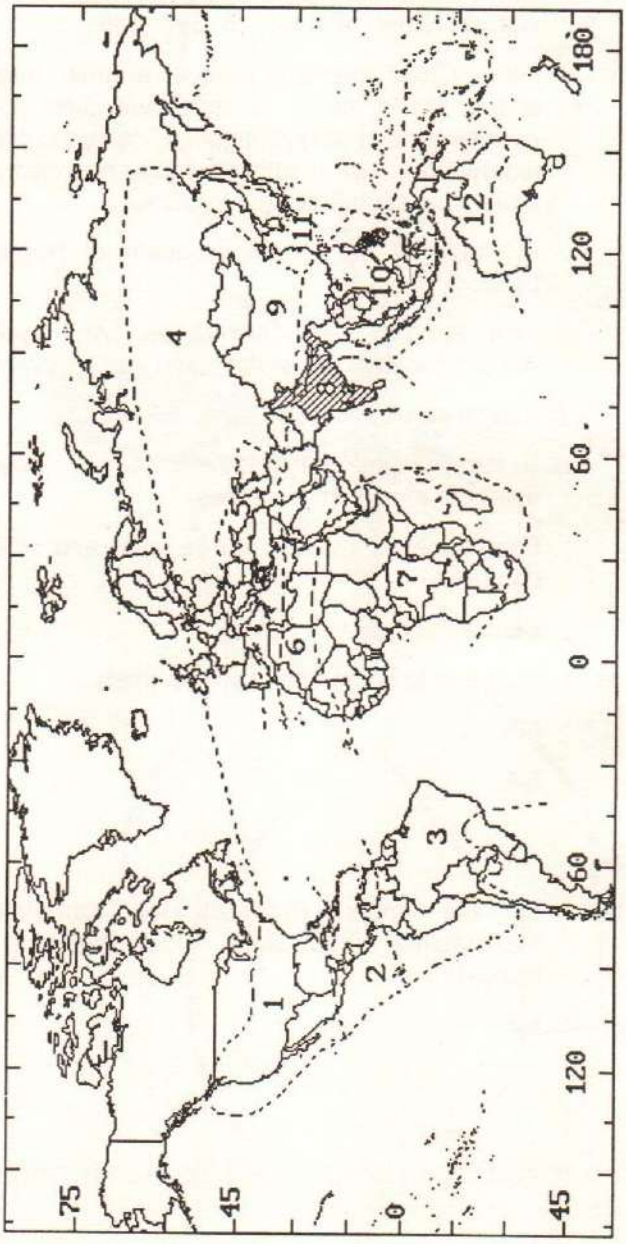
An. culiciformis Cogill 1903, main identification characters

1. Palpi completely dark but slightly shorter than proboscis
2. Wing completely dark
3. Legs completely dark

Further identification is based on larval characters

Anopheles culiciformis

Name	:	*An. culiciformis* Cogill, 1903. *Journal of the Bombay Natural History Society*, **15**: 327–336.
Derivative	:	Latin, *Culex* (genitive *culicis*), a gnat, midge; *forma*, shape, figure, form; *-is*, adjectival suffix. Cogill treats *culiciformis* and *aitkenii* together, named *culiciformis* as it resembles *Culex* in sitting posture, has clear wings and abdominal segments light in colour.
Type form	:	Available at the British Museum of Natural History, London.
Species complex	:	Five species (*An. alongensis, An. kyondawensis, An. sintonoides, An. sintoni,* and *An. culiciformis*).
Sitting posture	:	Body parallel to resting surface.
Resting habit	:	Rests indoors preferably in human dwellings and outdoors mostly in tree holes.
Breeding ecology	:	Forest species, breeds in tree holes and in fallen or cut bamboos.
Biting time	:	Before midnight.
Feeding preference	:	Man and to some extent wild animals.
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	NA
Reported distribution	:	In India, Andhra Pradesh, Goa, Karnataka, Kerala, Maharashtra, Tamil Nadu, Uttar Pradesh, and West Bengal.
Vector incrimination	:	NA



Reported distribution of *An. culiciformis* in the World.

ANDHRA PRADESH (AP)
1. Chittoor

GOA (GOA)
1. Goa

KARNATAKA (KAR)
1. North Kanara

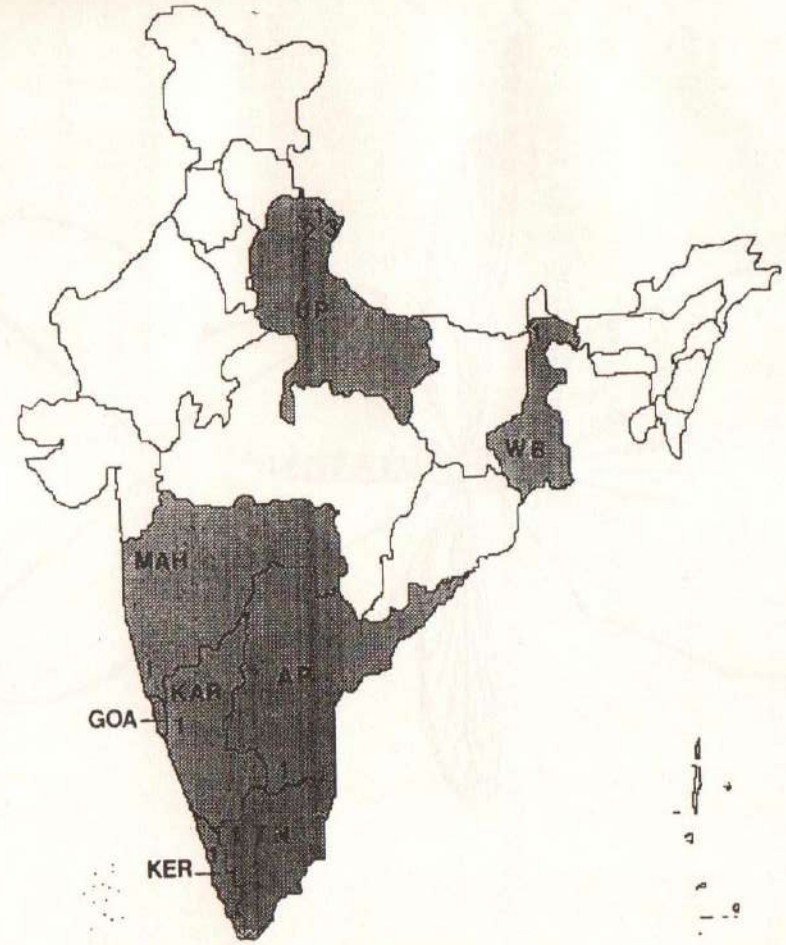
KERALA (KER)
1. Malappuram

MAHARASHTRA (MAH)
1. Ratnagiri

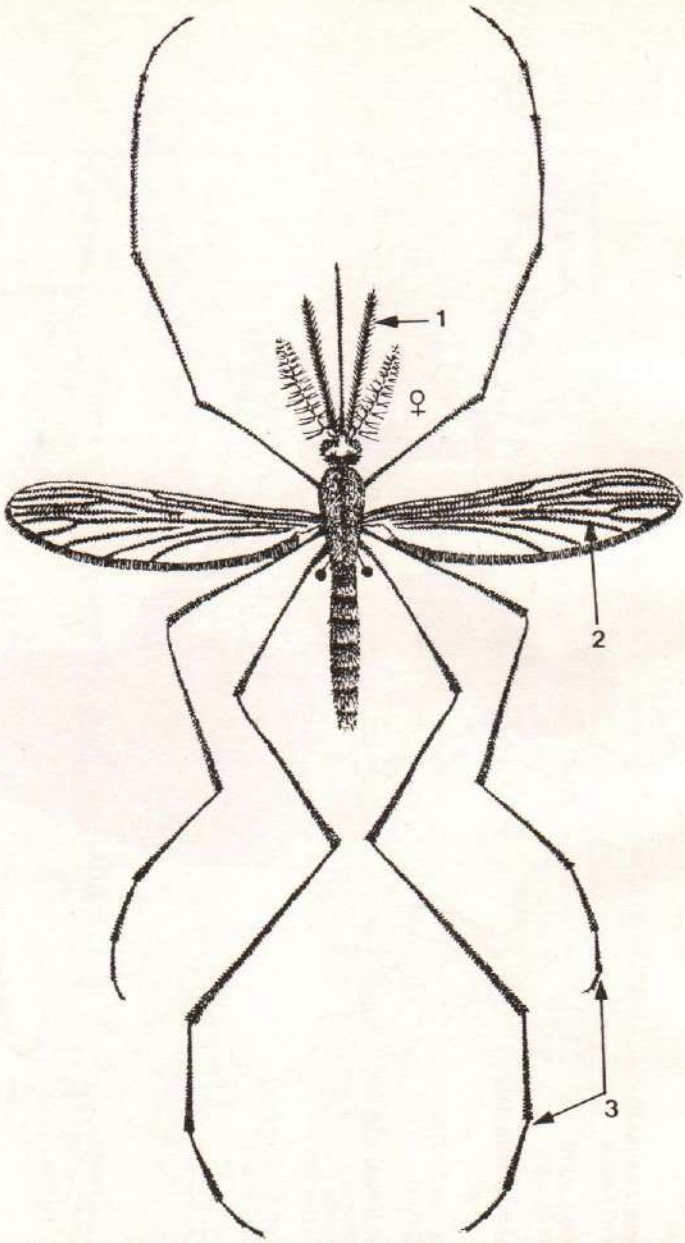
TAMIL NADU (TN)
1. Nilgiris

UTTAR PRADESH (UP)
1. Chamoli
2. Almora
3. Pithoragarh

WEST BENGAL (WB)
1. Darjeeling



Reported distribution of *An. culiciformis* in India.



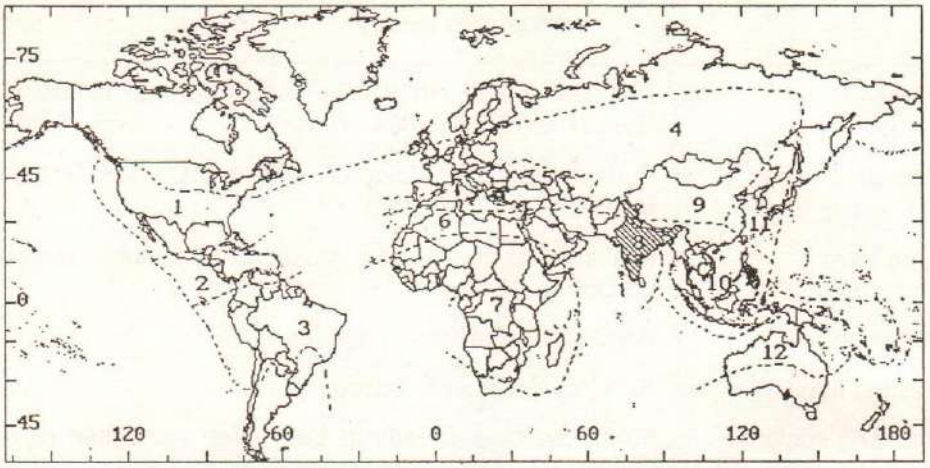
An. sintoni Puri 1929, main identification characters

1. Palpi completely dark but slightly shorter than proboscis
2. Wing completely dark
3. Legs completely dark

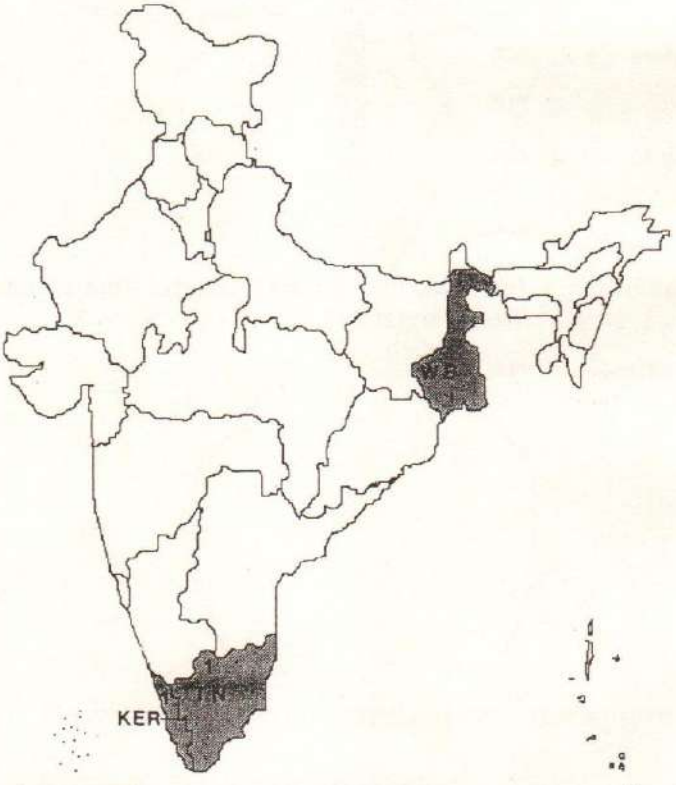
Further identification is based on larval characters

Anopheles sintoni

Name	:	*An. sintoni* Puri, 1929. *The Indian Journal of Medical Research*, **17:** 397–404.
Derivative	:	Puri named it after Major J.A. Sinton, V.C., IMS, Director, Malaria Survey of India.
Type form	:	Available at the British Museum of Natural History, London.
Sitting posture	:	Body parallel to resting surface.
Resting habit	:	Rests outdoors and indoors.
Breeding ecology	:	Forest species, breeds in tree holes and fallen or cut bamboos.
Biting time	:	Before midnight.
Feeding preference	:	NA
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	NA
Reported distribution	:	Recorded from the west coast of Kerala, Tamil Nadu, and West Bengal.
Vector incrimination	:	NA



Reported distribution of *An. sintoni* in the World.



KERALA (KER)
1. Calicut

WEST BENGAL (WB)
1. Darjeeling

TAMIL NADU (TN)
1. Nilgiris

Reported distribution of *An. sintoni* in India.

2.2 An. aitkenii, An. bengalensis, An. insulaeflorum, An. pinjaurensis* An. barianensis**

Wing completely dark

Head scales small in size

Femur and tibia with a pale band at their termination

Setae on prescutellar space of thorax

Present

An. insulaeflorum

The species can be confirmed by the larval characters

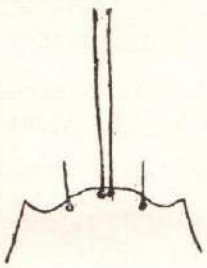
Absent

An. bengalensis
An. aitkenii

Further identification based on larval characters

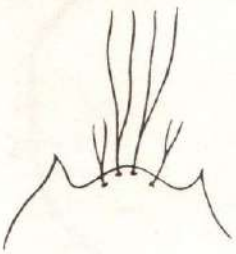
Larval characters

Inner clypeal hair (2c; clypeal hair 2) simple and rarely bifid; palmate hair (1-III, hair no. 1 of abdominal segment III) present on abdominal segments 1 to 7



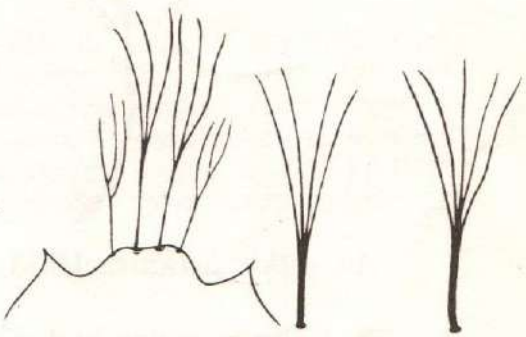
Branches of inner clypeal hair

Inner clypeal hair (2c; clypeal hair 2) dividing about 1/4 way from base into 2 or sometimes 3 branches



An. aitkenii

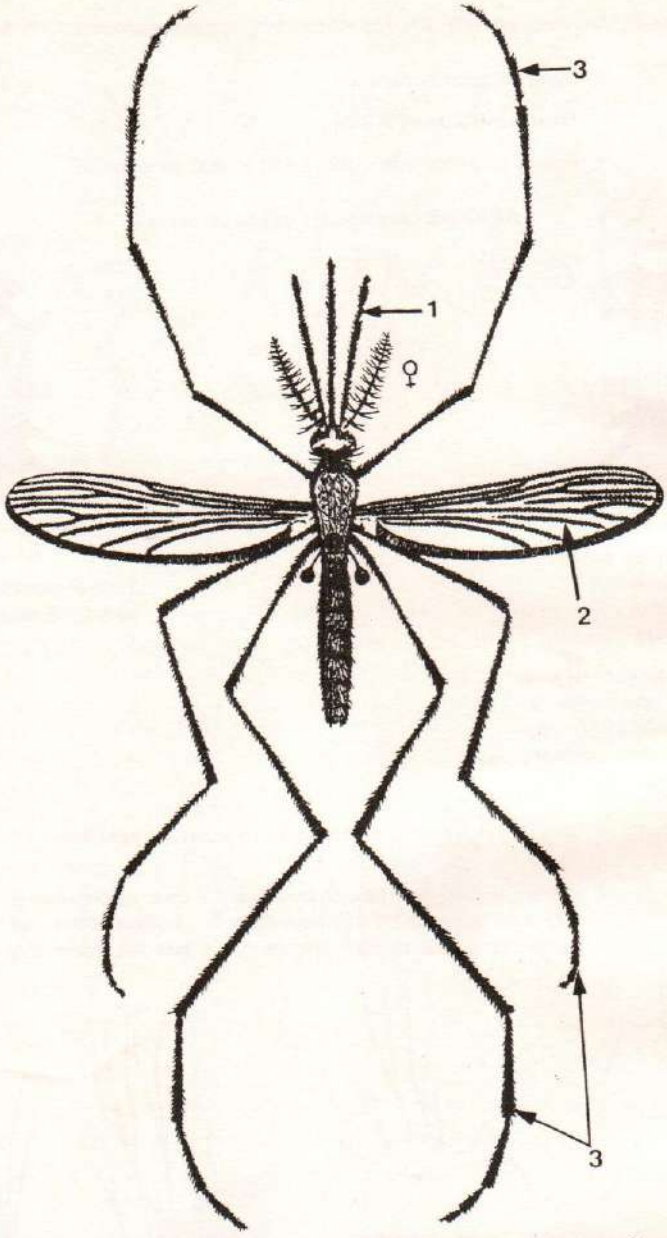
Inner clypeal hair (2c; clypeal hair 2) dividing about half way from base into 2-9 (commonly 4-7) branches



An. bengalensis

*Identification of this species based on male genitalia; phalosome, very long, somewhat expanded at the tip

**Identification of this species is given on page number 278



An. aitkenii James 1903, main identification characters

1. Palpi completely dark
2. Wing completely dark
3. Legs completely dark

Further identification is based on larval characters

Anopheles aitkenii

Name	:	*An. aitkenii* James, 1903. In: Theobald, *A Monograph of the Culicidae or Mosquitoes*, **3:** 22–23.
Derivative	:	James named it after E.H. Aitken (1851–1909) who collected this species in the Goa frontier and Karwar (Bombay Presidency).
Type form	:	Available at the British Museum of Natural History, London.
Species complex	:	Ten species (*An. palmatus, An. pinjaurensis, An. fragilis, An. tigertti, An. aitkenii, An. bengalensis, An. borneensis, An. acaci, An. insulaeflorum*, and *An. stricklandi*).
Sitting posture	:	Body parallel to resting surface.
Resting habit	:	Rests in shades of jungles and rarely enters houses.
Breeding ecology	:	Breeds in a variety of places such as small pools and seepages in the jungle, tea-garden drains which are shaded by tea plants, swamps, marshes, channels, river, rock pools, streams heavily shaded with trees, wells, etc.
Biting time	:	Exophilic and bites during the day.
Feeding preference	:	Wild animals but sometimes man.
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	NA
Reported distribution	:	Occurs in Bangladesh, China, India, Indonesia, West Iran, Malaysia, Myanmar, Nepal, the Philippines, Sri Lanka, and Thailand. In India, occurs in Andhra Pradesh, Assam, Bihar, Karnataka, Kerala, Maharashtra, Manipur, Meghalaya, Orissa, Punjab, Sikkim, Tamil Nadu, Uttar Pradesh, and West Bengal. Also occurs in Andaman Islands.
Vector incrimination	:	NA

Reported distribution of *An. aitkenii* in the World.

ANDAMAN NICOBAR ISLANDS (A&N)
1. Andaman Islands

ANDHRA PRADESH (AP)
1. Chittoor

ASSAM (ASS)
1. Cachar
2. Kamrup

BIHAR (BIH)
1. Singhbhum hills

KARNATAKA (KAR)
1. North Kanara
2. Coorg
3. Shimoga
4. Hassan
5. Mysore

KERALA (KER)
1. Wynaad

MAHARASHTRA (MAH)
1. Pune

MANIPUR (MAN)
1. Imphal

MEGHALAYA (MEG)
1. Shillong

ORISSA (ORI)
1. Mayurbhanj
2. Keonjhar
3. Koraput

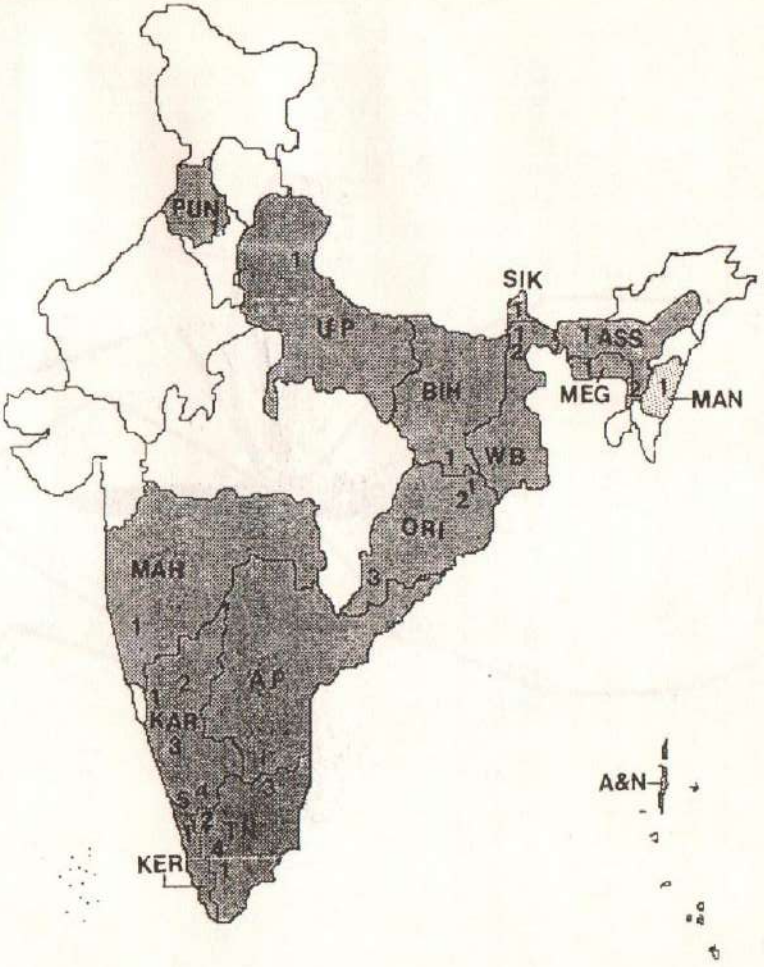
PUNJAB (PUN)
1. Patiala

SIKKIM (SIK)
1. Sikkim

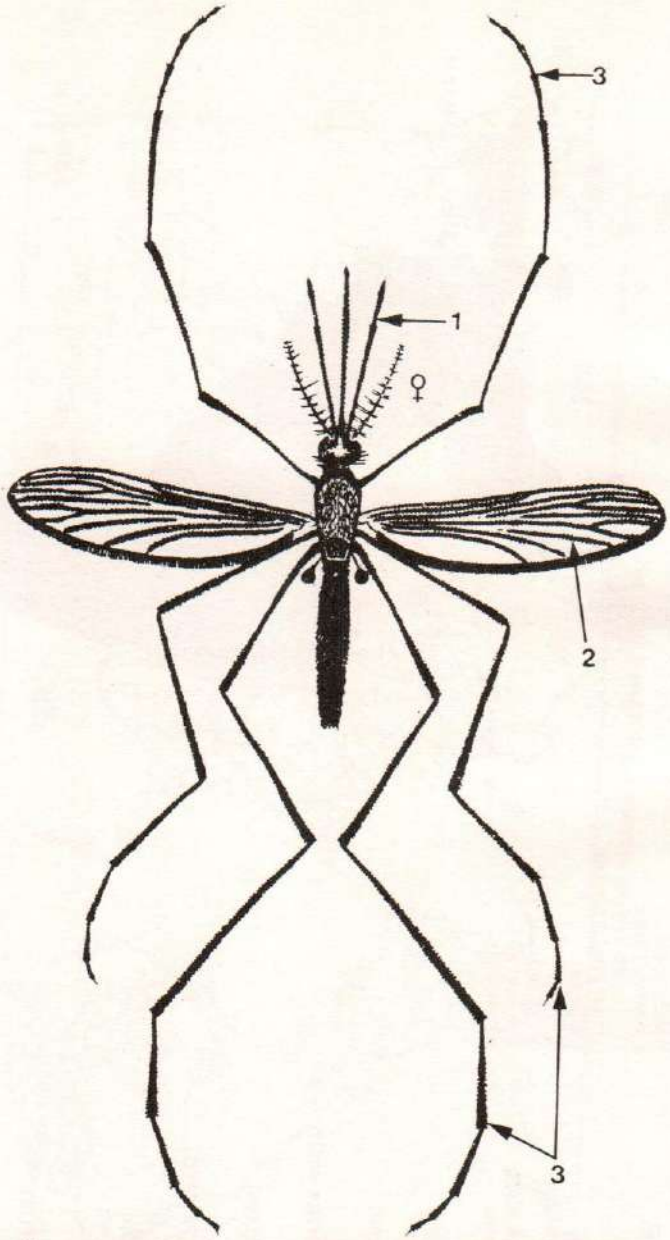
TAMIL NADU (TN)
1. Madurai
2. Nilgiris
3. North Arcot
4. Western Ghats

UTTAR PRADESH (UP)
1. Nainital

WEST BENGAL (WB)
1. Kurseong
2. Darjeeling



Reported distribution of *An. aitkenii* in India.



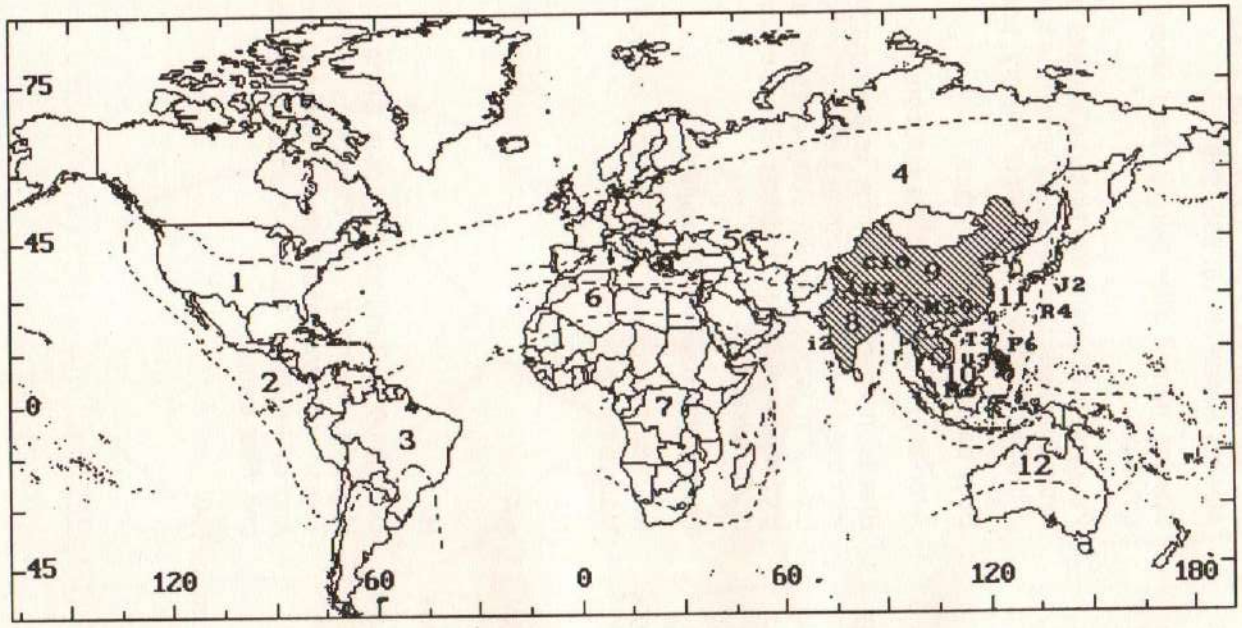
An. bengalensis Puri 1930, main identification characters

1. Palpi completely dark
2. Wing completely dark
3. Legs completely dark

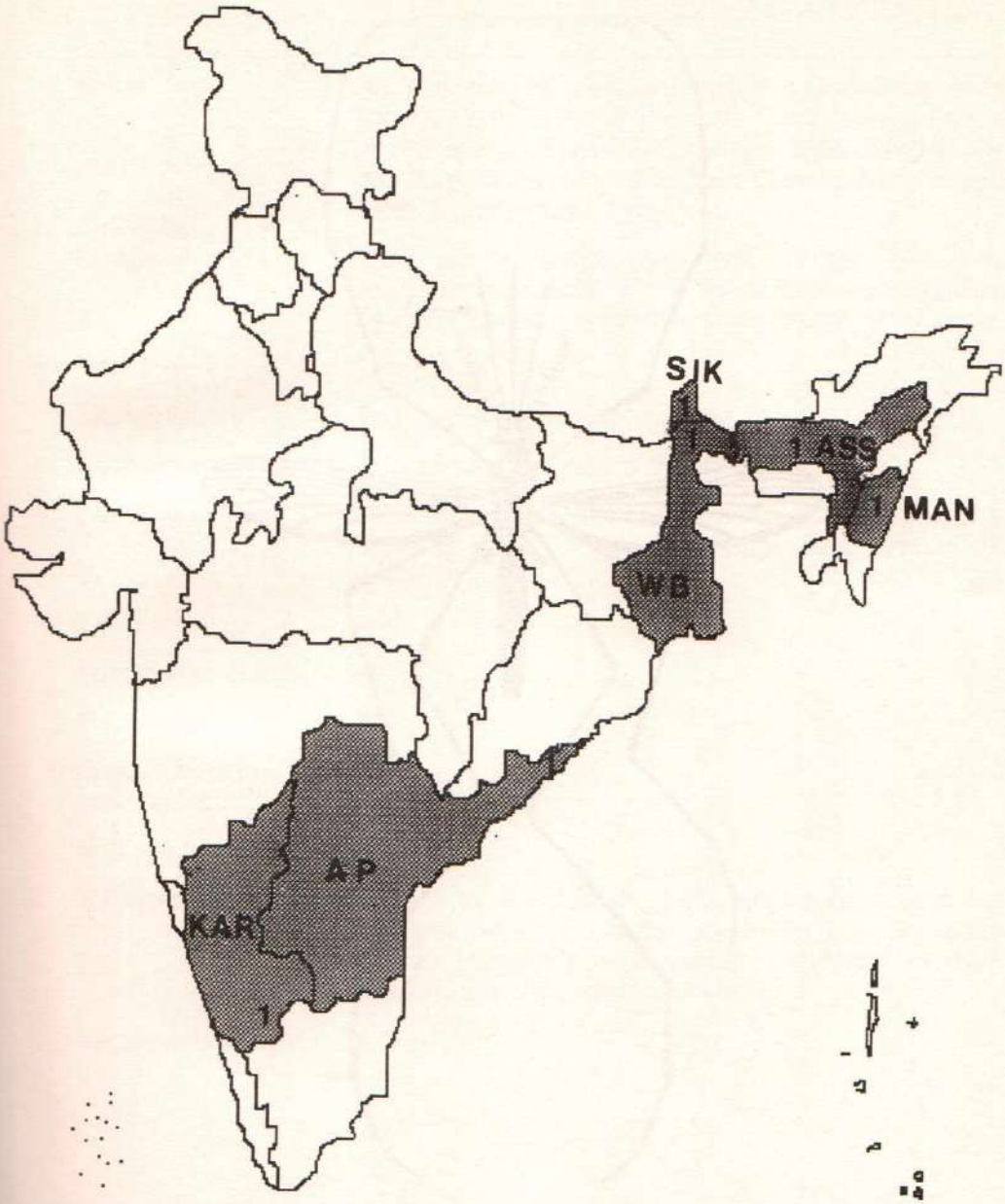
Further identification is based on larval characters

Anopheles bengalensis

Name	:	*An. bengalensis* Puri, 1930. *The Indian Journal of Medical Research*, **18:** 953–956.
Derivative	:	Species named after Bengal, from where it was first collected.
Type form	:	Paratype available in the National Institute of Communicable Diseases, Delhi, India. Original type form deposited in the British Museum of Natural History, London.
Sitting posture	:	Body parallel to resting surface.
Resting habit	:	A forest-loving species, rests outdoors.
Breeding ecology	:	Breeds in seepages, springs or slow running streams with dead leaves and floating debris of vegetation. Also breeds in isolated pools along streams, and bamboo groves; otherwise the breeding sites are similar to those of *An. aitkenii.*
Biting time	:	Bites during day-time in jungles.
Feeding preference	:	No record of feeding habit in India but in Thailand and Malaysia, mostly feeds on man.
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	NA
Reported distribution	:	Distributed in Bangladesh, South China, India, Japan, Malaysia, Myanmar, the Philippines, Ryukyu Islands, Taiwan, Thailand, and Vietnam. In India, recorded from Andhra Pradesh, Assam, Karnataka, Manipur, Sikkim, and West Bengal.
Vector incrimination	:	NA



Reported distribution of *An. bengalensis* in the World.



ANDHRA PRADESH (AP)
1. Vishakhapatnam

ASSAM (ASS)
1. Kamrup

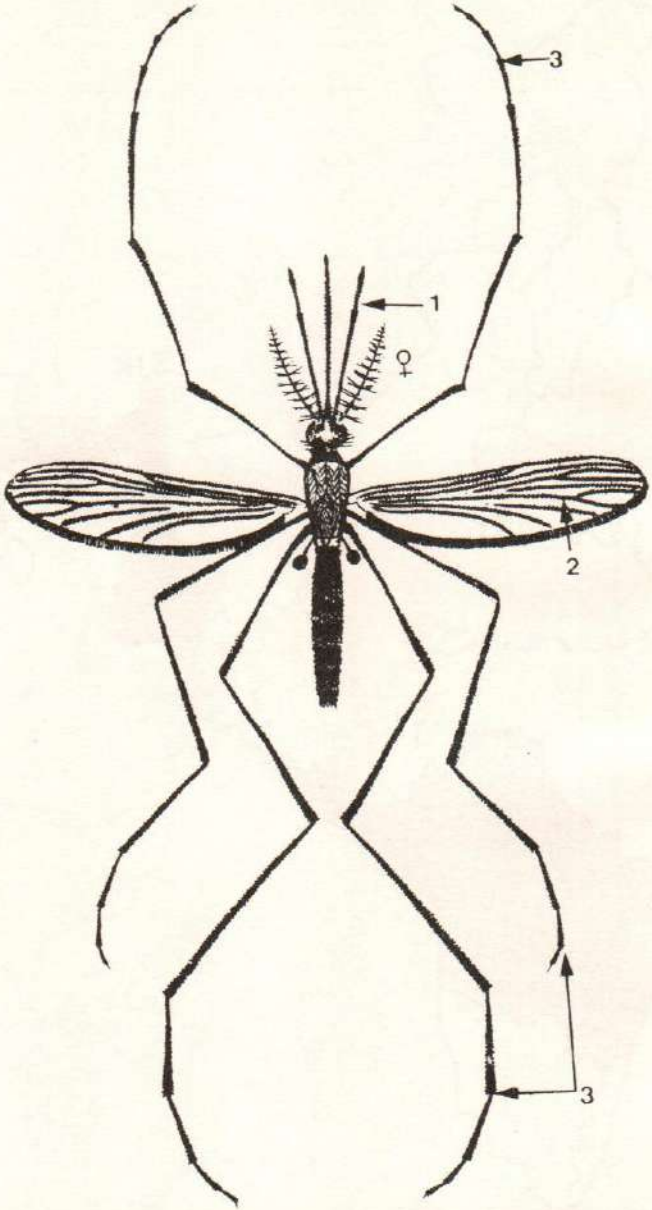
KARNATAKA (KAR)
1. Mysore

MANIPUR (MAN)
1. Imphal

SIKKIM (SIK)
1. Sikkim

WEST BENGAL (WB)
1. Kalimpong

Reported distribution of *An. bengalensis* in India.



An. insulaeflorum (Swellengrebel and Swellengrebel, de Graaf) 1919, main identification characters

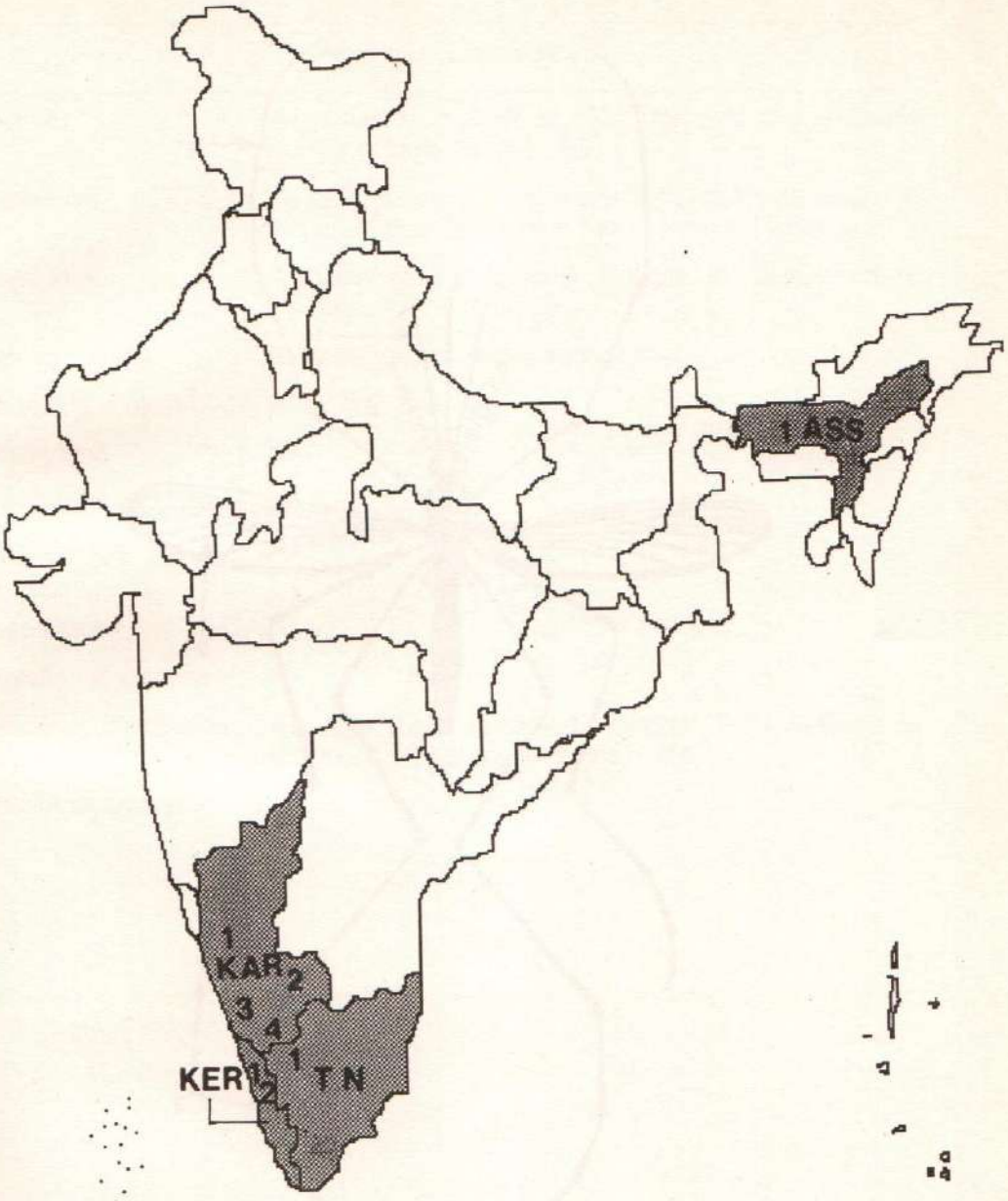
1. Palpi completely dark
2. Wing completely dark
3. Legs completely dark

Further identification is based on larval characters

Anopheles insulaeflorum

Name	:	*An. insulaeflorum* (Swellengrebel and Swellengrebel-de Graaf), 1919 (1920). Addenda to Description of Larvae of Netherlands Indian Anophelines. *Mededelingen van den Burgerlijken Geneeskundigen Dienst in Nederlansch-Indie*, **9** (addendum): 1–3.
Derivative	:	Latin, *insula,* island; *flos, floris*, flowers. The word *insulaeflorum* means "of the island of flowers"; chosen by the author as it is found in some islands of Moluccas.
Type form	:	Location not known.
Sitting posture	:	Body parallel to resting surface.
Resting habit	:	A forest species, rests outdoors.
Breeding ecology	:	Breeds in ground pools, rock pools, streams, margins, arecanut garden trenches, seepage pools, etc. in the shade.
Biting time	:	NA
Feeding preference	:	NA
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	NA
Reported distribution	:	Occurs in Bangladesh, India, Indonesia, Cambodia, Malaysia, Myanmar, Nepal, the Philippines, Sri Lanka, Taiwan, Thailand, and Vietnam. In India, found in Assam, Karnataka, Kerala, and Tamil Nadu.
Vector incrimination	:	NA

Reported distribution of *An. insulaeflorum* in the World.



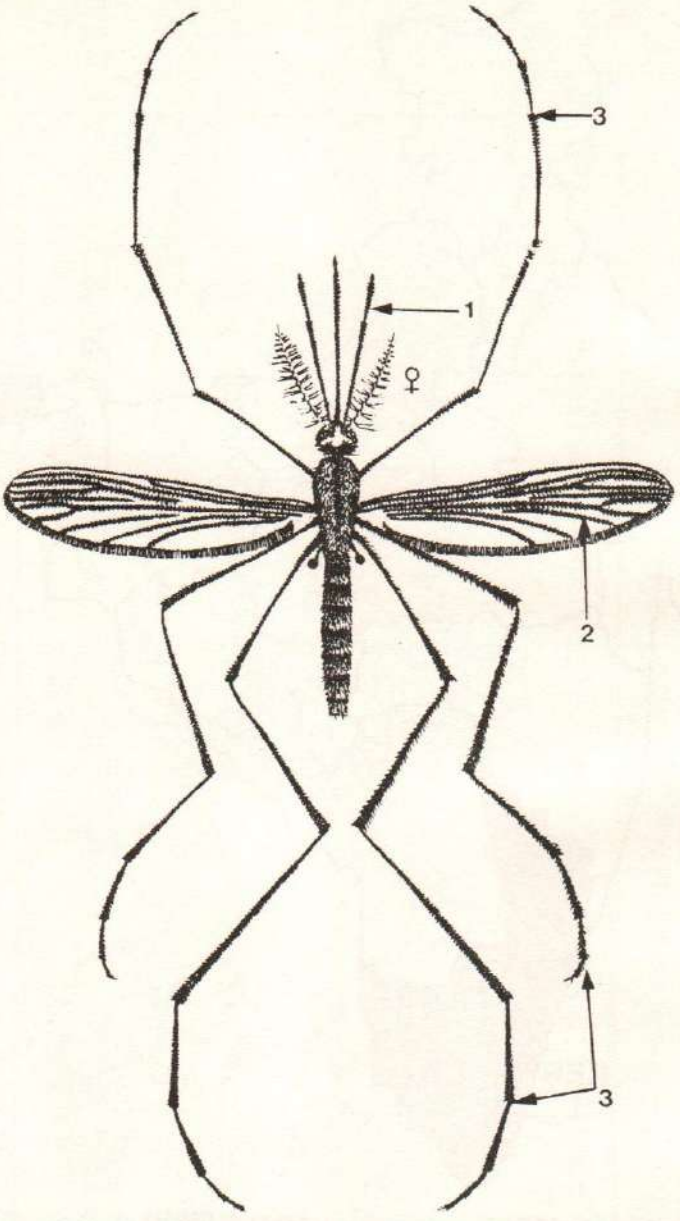
ASSAM (ASS)
1. Kamrup

KARNATAKA (KAR)
1. North Kanara
2. Shimoga
3. Hassan
4. Mysore

KERALA (KER)
1. Calicut
2. Malappuram

TAMIL NADU (TN)
1. Nilgiris

Reported distribution of *An. insulaeflorum* in India.



An. pinjaurensis Barraud 1932, main identification characters

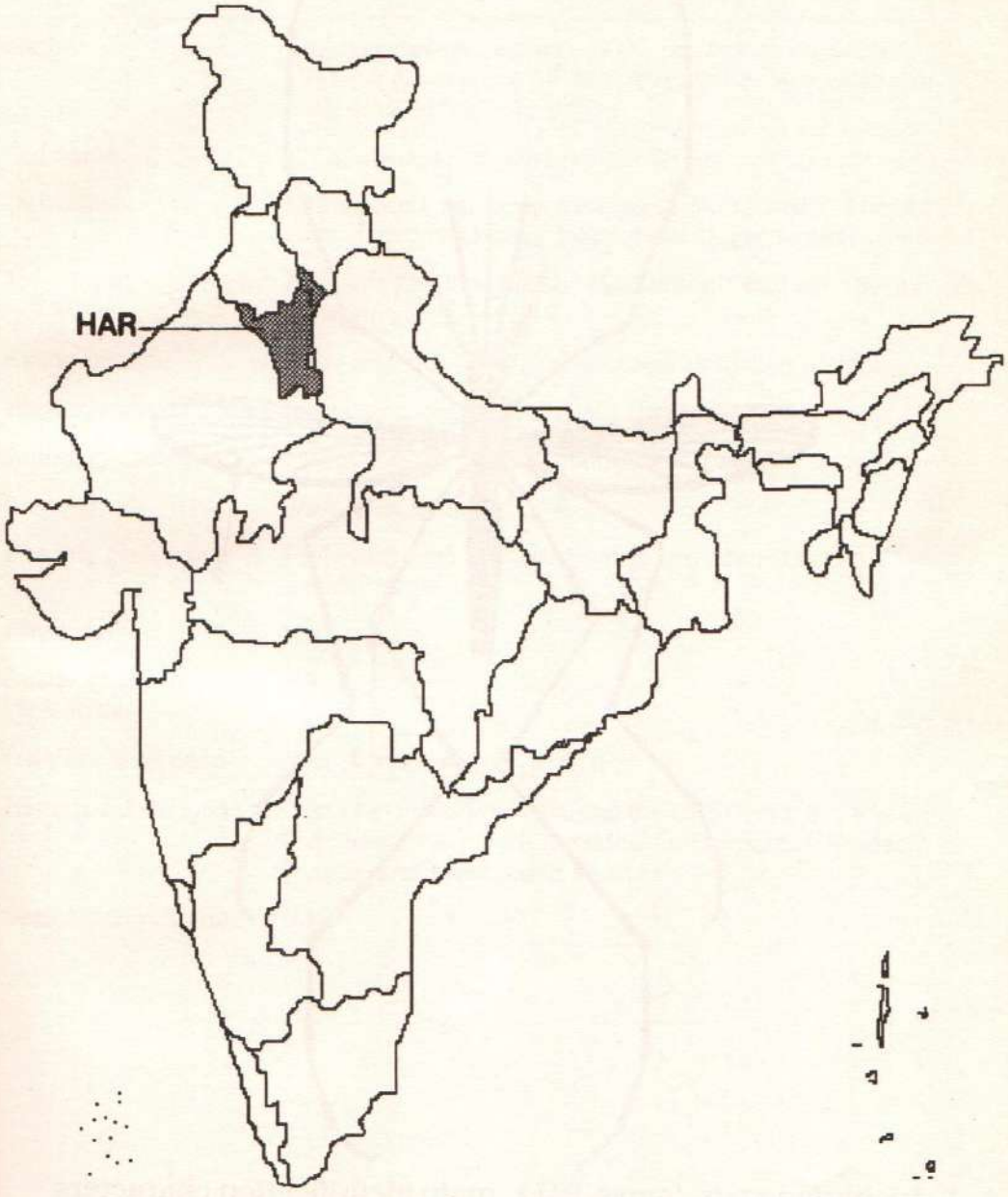
1. Palpi completely dark
2. Wing completely dark
3. Legs completely dark

Further identification is based on male genetilia characters

Anopheles pinjaurensis

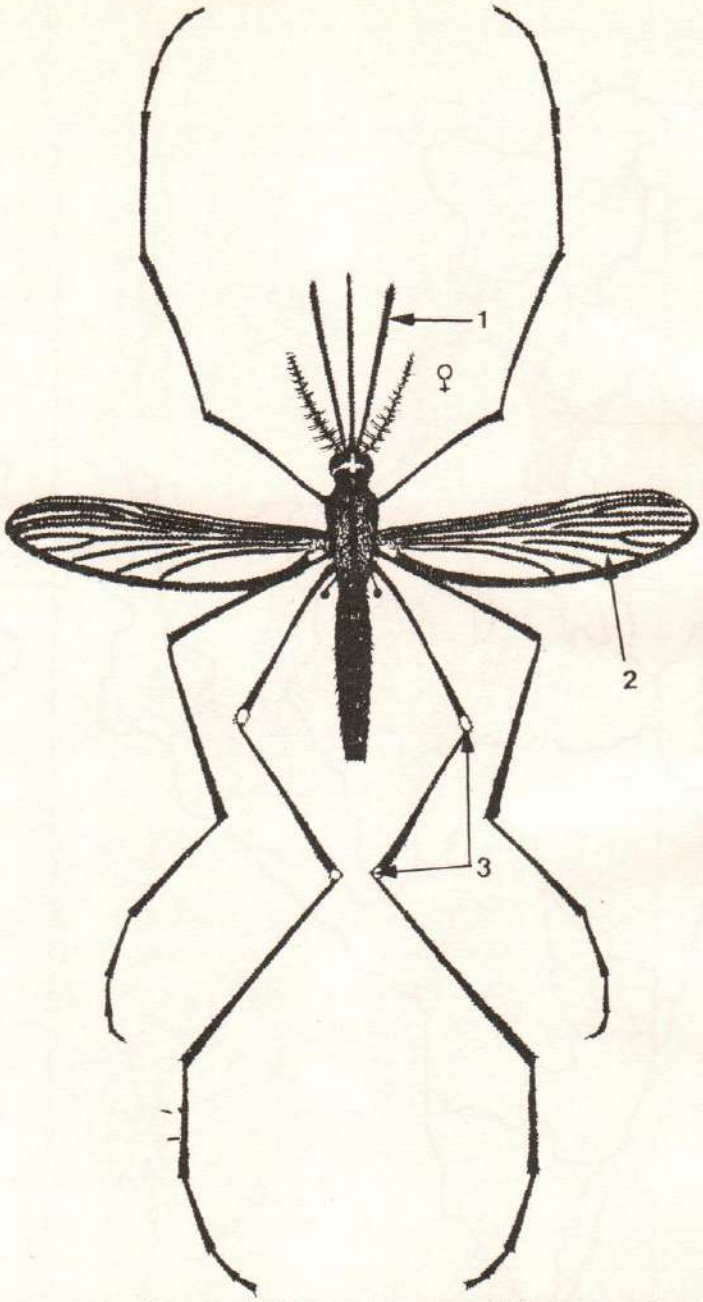
Name	:	*An. pinjaurensis* Barraud, 1932. *Records of the Malaria Survey of India*, **3:** 353–355.
Derivative	:	Barraud named it *pinjaurensis* because it was caught at Pinjaur Patiala State, near Kalka, (now in Haryana).
Type form	:	Available at the National Institute of Communicable Diseases, Delhi, India.
Sitting posture	:	Body parallel to resting surface.
Breeding ecology	:	NA
Biting time	:	NA
Feeding preference	:	NA
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	NA
Reported distribution	:	A single male specimen collected from Pinjaur(now Pinjore, near Kalka,), Haryana, India.
Vector incrimination	:	NA

Reported distribution of *An. pinjaurensis* in the World.



HARYANA (HAR)
1. Pinjaur (Pinjore)

Reported distribution of *An. pinjaurensis* in India.



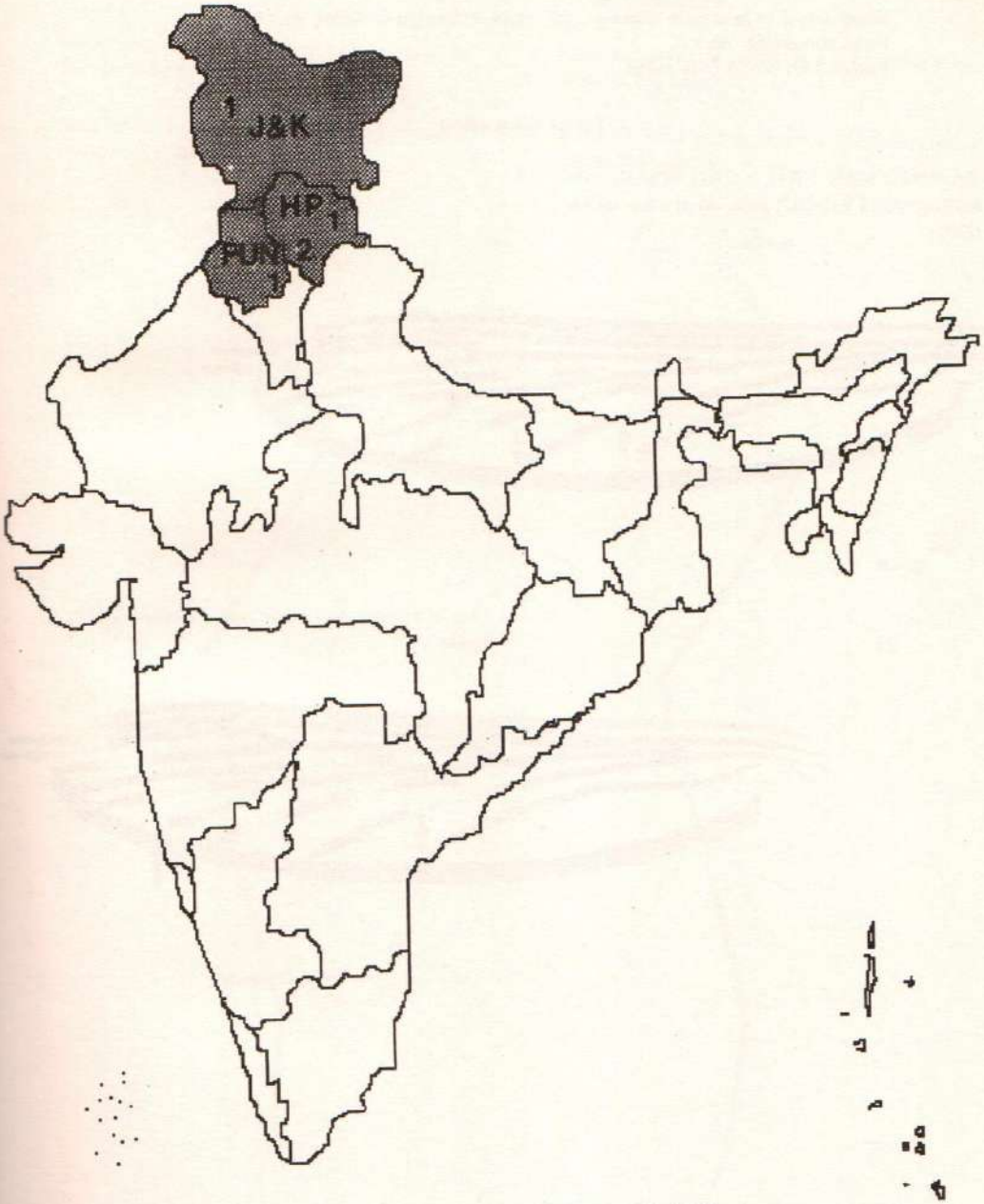
An. barianensis James 1911, main identification characters

1. Palpi completely dark
2. Wing completely dark
3. Pale band at the termination of femur and tibia of hind leg

Anopheles barianensis

Name	:	*An. barianensis* James, 1911. In: James and Liston, 1911, *A Monograph of the Anopheline Mosquitoes of India*, 2nd edition, 128 pages.
Old name	:	*An. plumbeus* var. *barianensis James*.
Derivative	:	Named after the locality Barian in Murree hills, Punjab, India (now in Pakistan) from where first collected.
Type form	:	Available at the British Museum of Natural History, London.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Rests outdoors in tree holes, also indoors.
Breeding ecology	:	Forest species, breeds mainly in tree holes.
Biting time	:	Soon after dusk.
Feeding preference	:	Preferably man and wild animals. Also cannibalistic at the aquatic stage.
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	NA
Reported distribution	:	Occurs in India, Pakistan, and the USSR. In India, known only from the northern states i.e. Himachal Pradesh, Punjab, and Jammu and Kashmir.
Vector incrimination	:	NA

Reported distribution of *An. barianensis* in the World.



JAMMU & KASHMIR (J&K)
1. Srinagar

HIMACHAL PRADESH (HP)
1. Shimla
2. Kasuali

PUNJAB (PUN)
1. Patiala

Reported distribution of *An. barianensis* in India.

2.3. An. lindesayi, An. nilgiricus

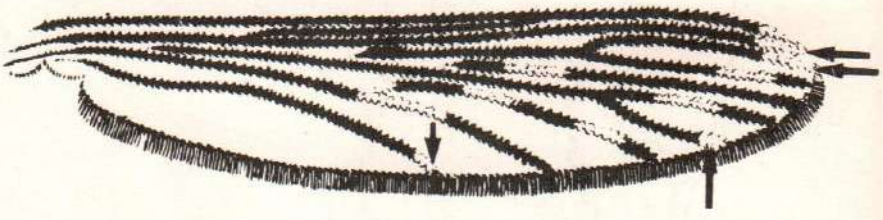
Wing with 3 or less pale areas on the costa, subcosta including vein1 (R1)
Palpi completely dark
Femur with broad pale areas

Tip of wing veins

Tip of wing veins 1(R1), 2.1(R2), 6(Anal), and sometimes of 5.2(Cu2) pale, tip of other veins dark

An. nilgirius

Tip of at least one other vein, usually 4.2(M2) pale



An. lindesayi

An. nilgiricus

Other characters

Hind femur with a pale ring, nearly equal to the diameter of the femur

Base of hind femur with a pale ring of about equal width above and below

Remigum with yellow scales

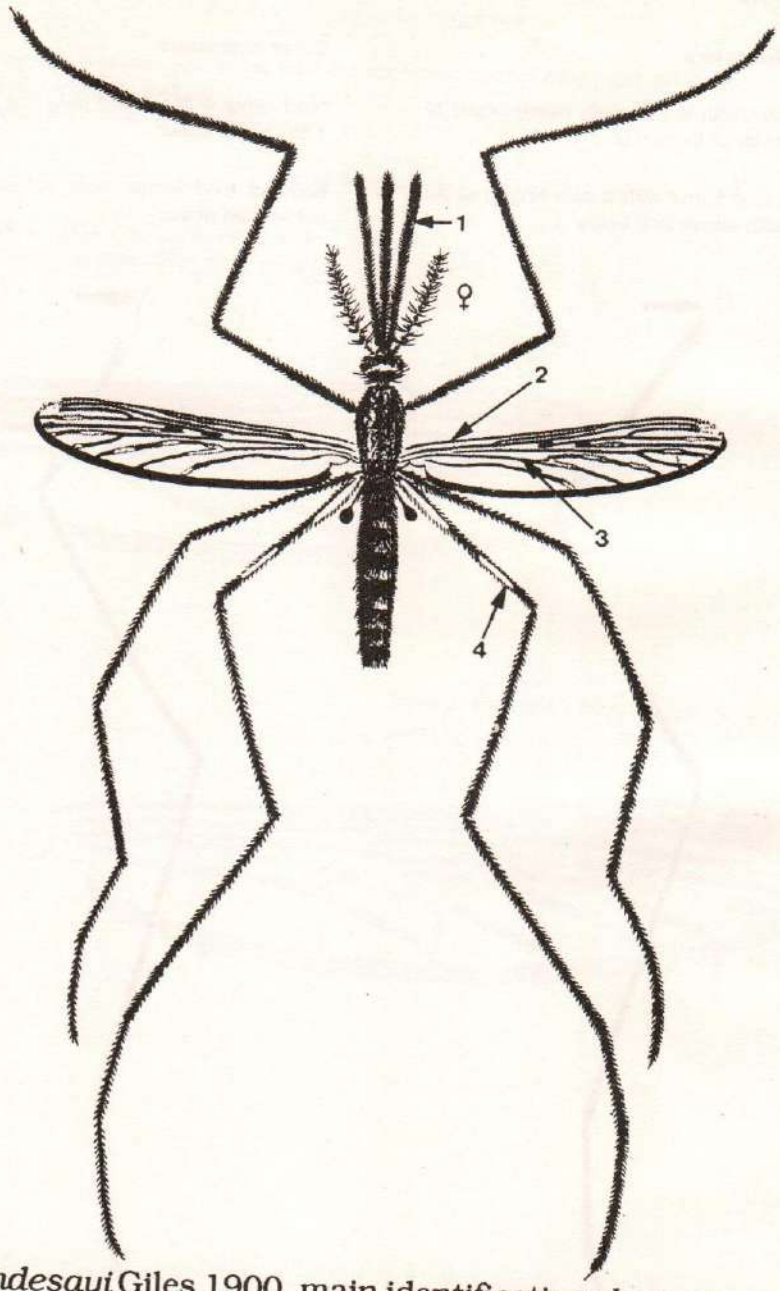
An. lindesayi

Other characters

Hind femur with a broad pale ring, occupying 1/5th of the femur

Base of hind femur more extensively pale below than above

Wing veins 3(R4+5) and 6(Anal) are mainly dark

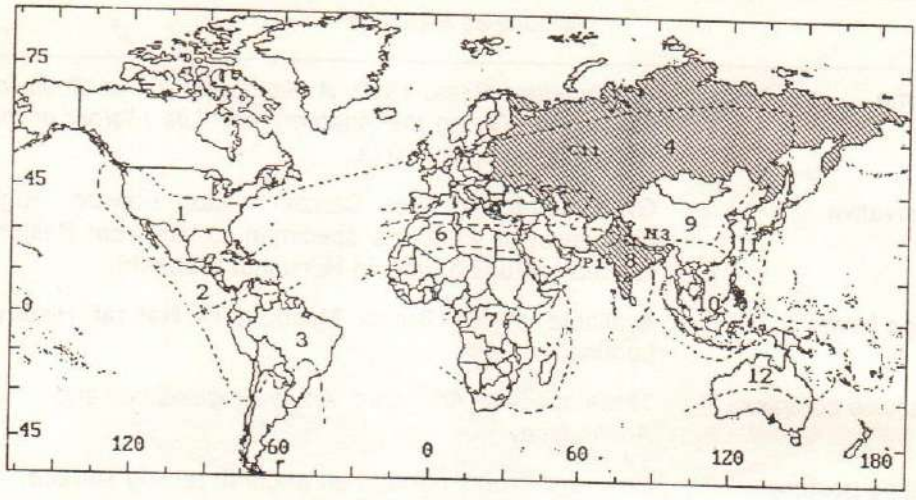


An. lindesayi Giles 1900, main identification characters

1. Palpi completely dark
2. Inner costa completely dark
3. Stem of vein 5 (CU) completely dark
4. Hind femur with a pale band

Anopheles lindesayi

Name	:	*An. lindesayi* Giles, 1900. *A Handbook of the Gnats or Mosquitoes Giving the Anatomy and Life History of the Culicidae*, Ist edition, 374.
Derivative	:	Giles named it after Captain Victor Edward Hugh Lindesay who sent this specimen to him from Bakloh, located in Punjab (now in Himachal Pradesh).
Type form	:	Available at the British Museum of Natural History, London.
Species complex	:	Three species (*An. gigas, An. wellingtonianus* and *An. lindesayi*).
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	A wild and high altitude species, recorded up to 2700 m. Rests outdoors or in human dwellings and chicken coops.
Breeding ecology	:	Stream bed pools are the common breeding sites although it also breeds in ground pools, mountain streams, ricefields and borrowpits.
Biting time	:	Bites outdoors and indoors, biting commences during the day in jungles and also at dusk near breeding sites.
Feeding preference	:	Preferably wild animals and man.
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	NA
Reported distribution	:	Occurs in India, Myanmar, Nepal, Pakistan, and USSR. In India, recorded from Assam, Himachal Pradesh, Jammu and Kashmir, Manipur, Punjab, Sikkim, Tamil Nadu, Uttar Pradesh, and West Bengal.
Vector incrimination	:	NA



Reported distribution of *An. lindesayi* in the world.

ASSAM (ASS)
1. Kamrup

HIMACHAL PRADESH (HP)
1. Kangra
2. Bilaspur
3. Solan

JAMMU & KASHMIR (J & K)
1. Srinagar
2. Gulmarg

MANIPUR (MAN)
1. Imphal

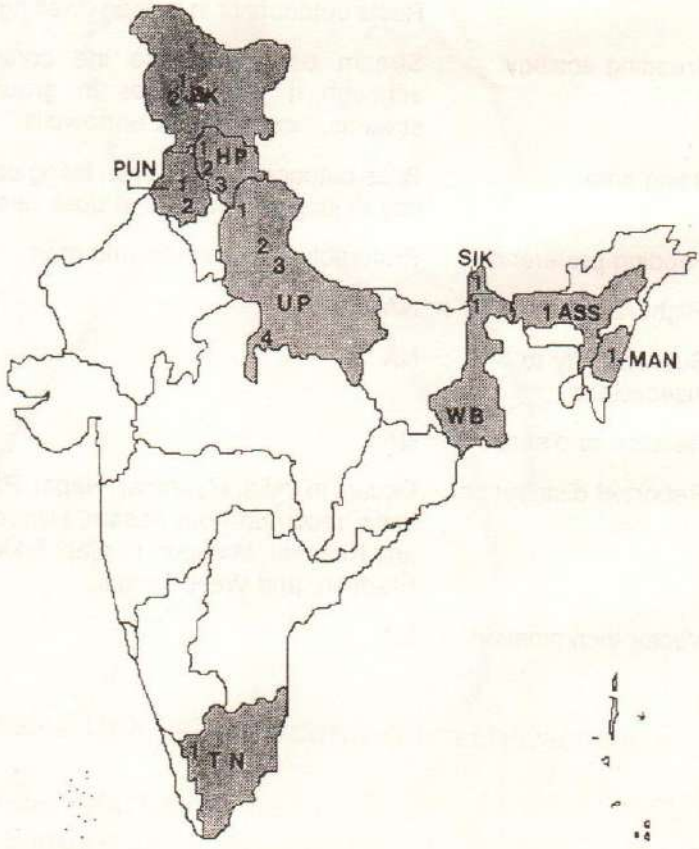
PUNJAB (PUN)
1. Ferozepur
2. Patiala

SIKKIM (SIK)
1. Sikkim

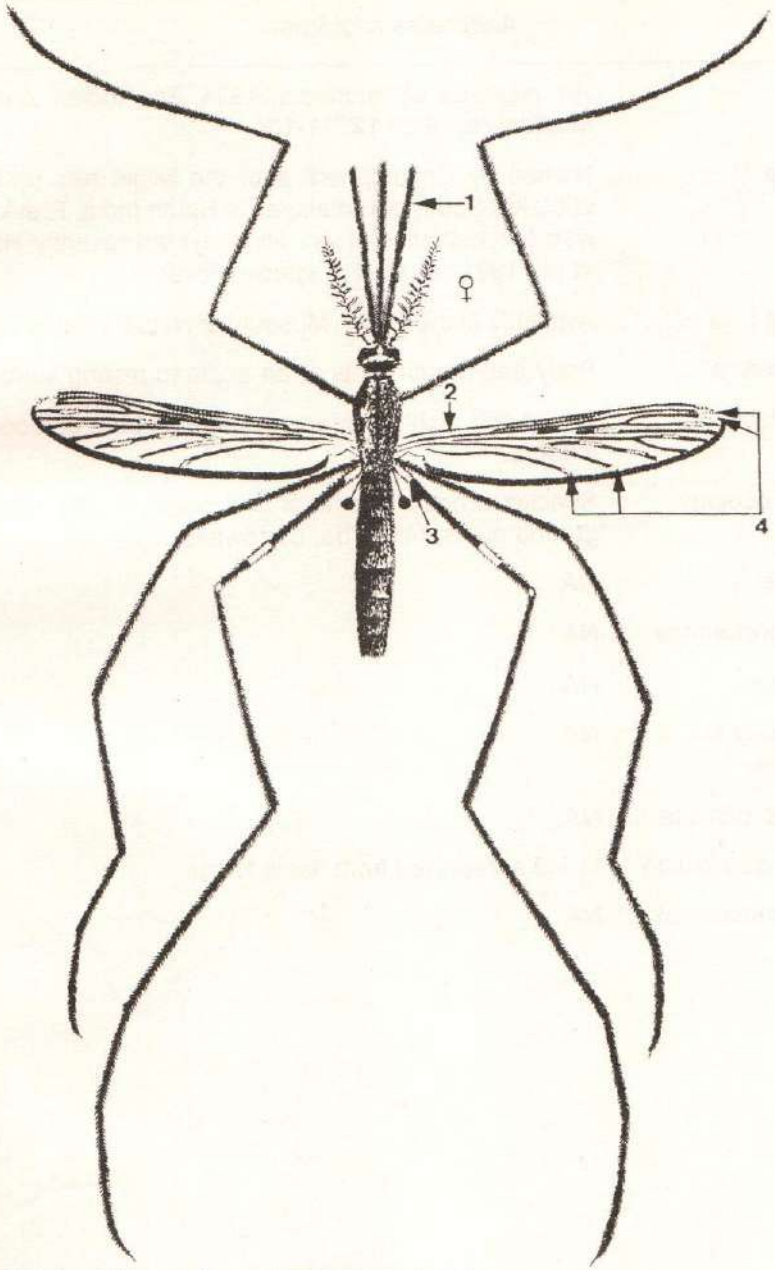
TAMIL NADU (TN)
1. Nilgiris

UTTAR PRADESH (UP)
1. Almora
2. Chamoli
3. Dehra Dun
4. Nainital

WEST BENGAL (WB)
1. Darjeeling



Reported distribution of *An. lindesayi* in India.

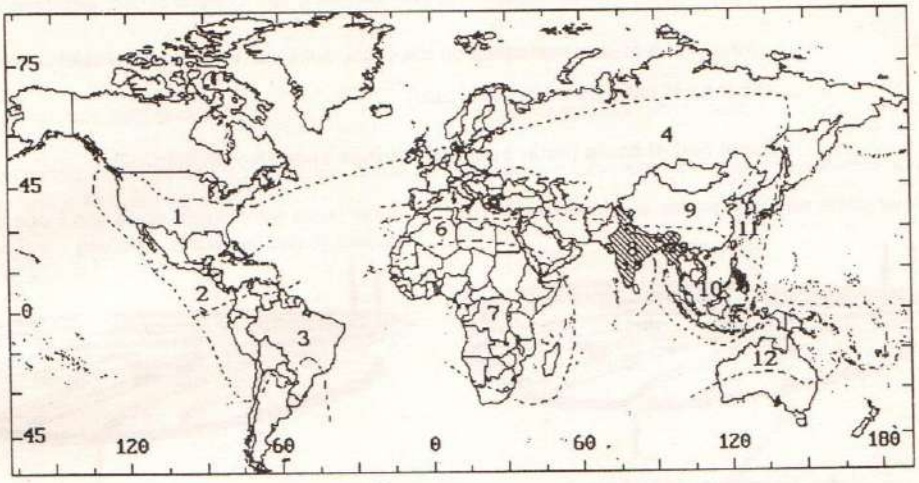


An. nilgiricus Christophers 1924, main identification characters

1. Palpi completely dark
2. Inner costa completely dark
3. Hind femur with a pale band
4. Tip of veins 1(R1), 2.1(R2), 6(Anal vein) and sometimes of 5.2 (CU2) pale.

Anopheles nilgiricus

Name	:	*An. nilgiricus* Christophers, 1924. The *Indian Journal of Medical research* **12**: 11-13.
Derivative	:	Named by Christophers after the Nilgiri hills (2000 m), 2000 km South of Himalayas in South India. Previously it was a subspecies of *An. lindesayi* but recently Harrison et al., 1991 raised it to species level.
Type form	:	Available at the British Museum of Natual History London.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	A wild and high altitude species rests both outdoors and indoors.
Breeding ecology	:	Species breeds in stream bed pools. It also breeds in ground pools, ricefields, borrowpits.
Biting time	:	NA
Feeding preferance	:	NA
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	NA
Reported distribution	:	In India, reported from Tamil Nadu.
Vector incrimination	:	NA



Reported distribution of *An. nilgiricus* in the World.

Reported distribution of *An. nilgiricus* in India.

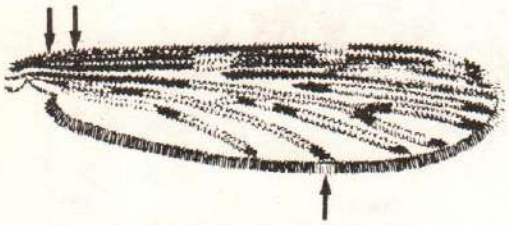
2.4. An. nigerrimus, An. nitidus, An. argyropus, An. sinensis, An. crawfordi, An. peditaeniatus

Wing with 3 or less pale areas on the costa, subcosta including vein 1(R1)

Four band palpi (tip of the palpi pale)

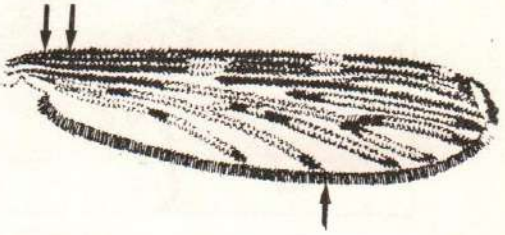
Basal half of costa (inner costa) and fringe spot on vein 5.2(Cu2)

Inner costa with pale scales and fringe spot



An. nigerrimus, An. nitidus

Inner costa without pale scale and fringe spot absent (exception in *An. sinensis*)



An. sinensis, An. peditaeniatus, An. argyropus, An. crawfordi

Size of basal dark mark on wing vein 5(Cu)

Small (0.2 x length of the stem of vein 5(Cu))

An. nitidus

Long (0.4 x length of the stem of vein 5(Cu))

An. nigerrimus

An. nitidus, An. nigerrimus

Other characters

Humeral pale spot present

Hind tarsomeres with broad pale bands, fourth segment with basal pale band

An. nitidus

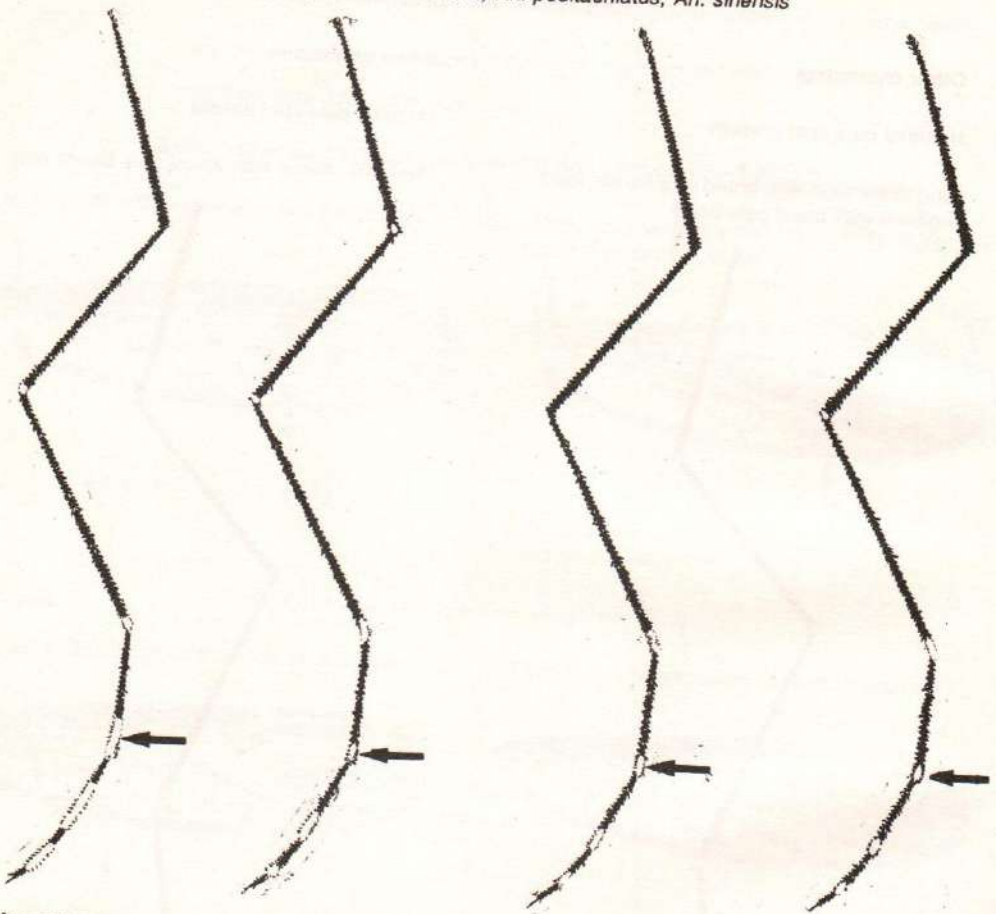
Other characters

Humeral pale spot absent

Hind tarsomeres with apical pale bands only

An. nigerrimus

An. argyropus, An. crawfordi, An. peditaeniatus, An. sinensis



An. argyropus

An. crawfordi

An. peditaeniatus

An. sinensis

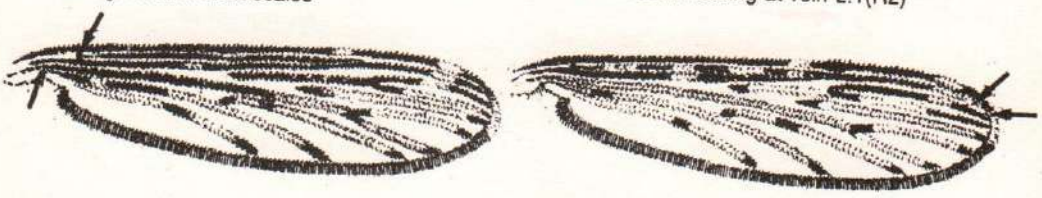
Other characters

Humeral cross vein with patch of dark scales

Remigium with dark scales

Other characters

Tip of the vein 1(R1) pale, apical fringe spot short commencing at vein 2.1(R2)



An. argyropus

An. crawfordi

An. peditaeniatus, An. sinensis

Other characters

Humeral cross vein with pale scales

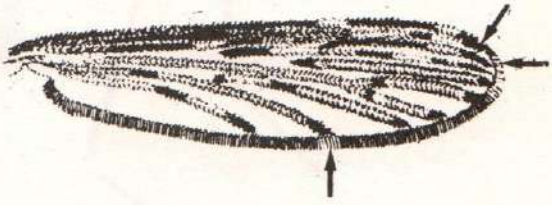
Remigium with pale scales

An. peditaeniatus

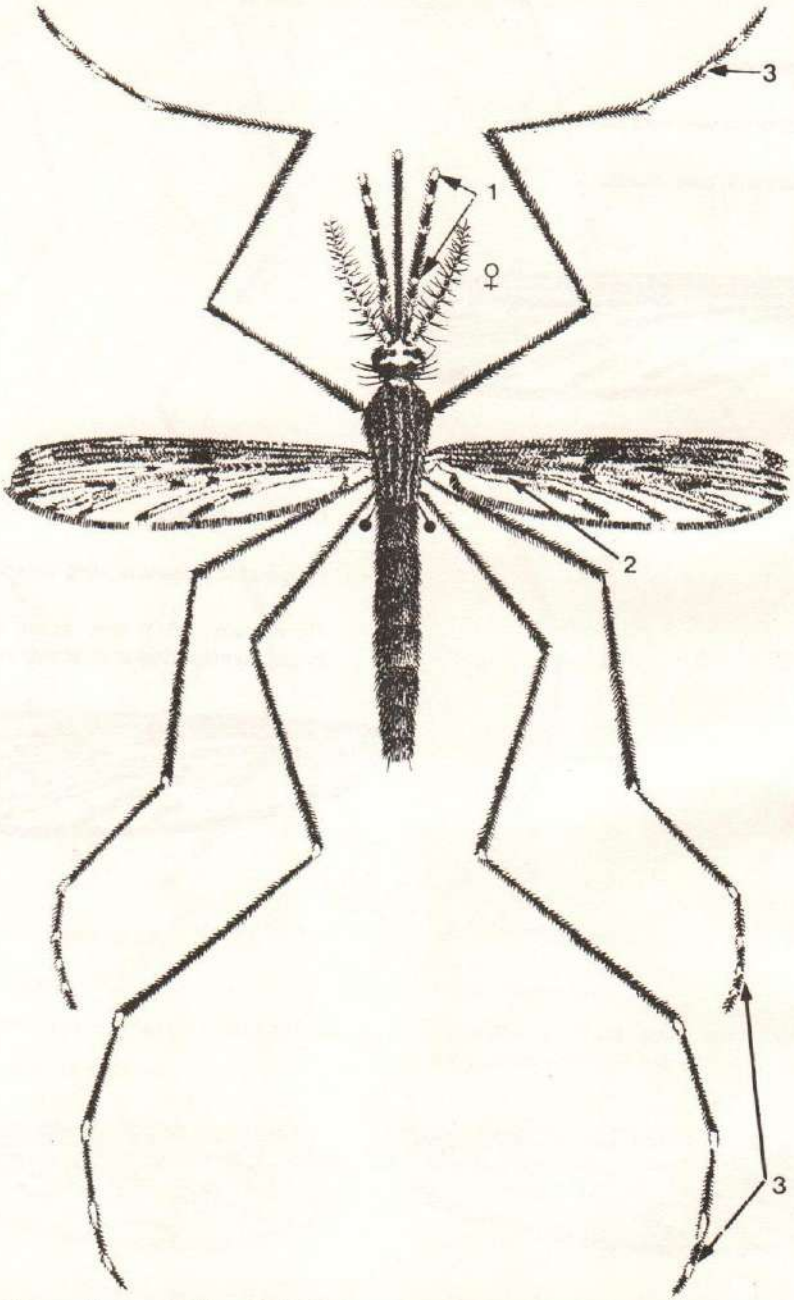
Other characters

Fringe spot present at wing vein 5.2(Cu2)

Tip of vein 1(R1) dark, apical fringe spot longer commencing at or above vein 1(R1)



An. sinensis

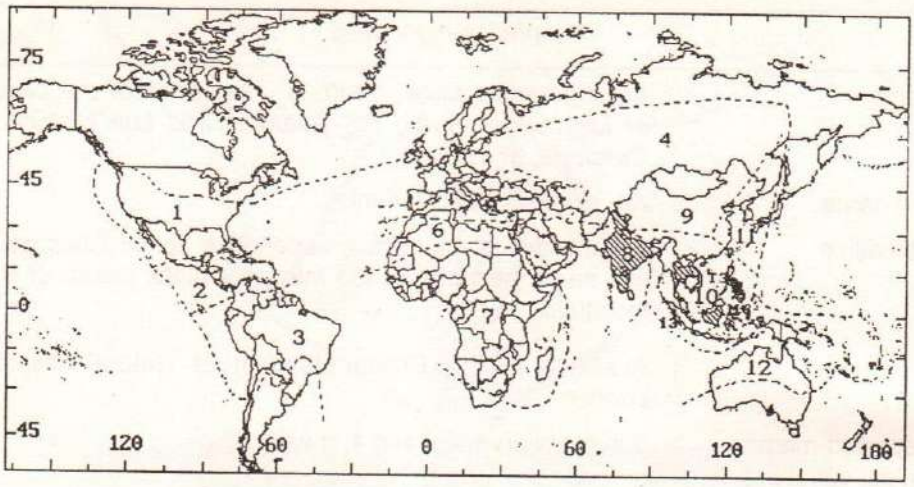


An. nigerrimus Giles 1900, main identification characters

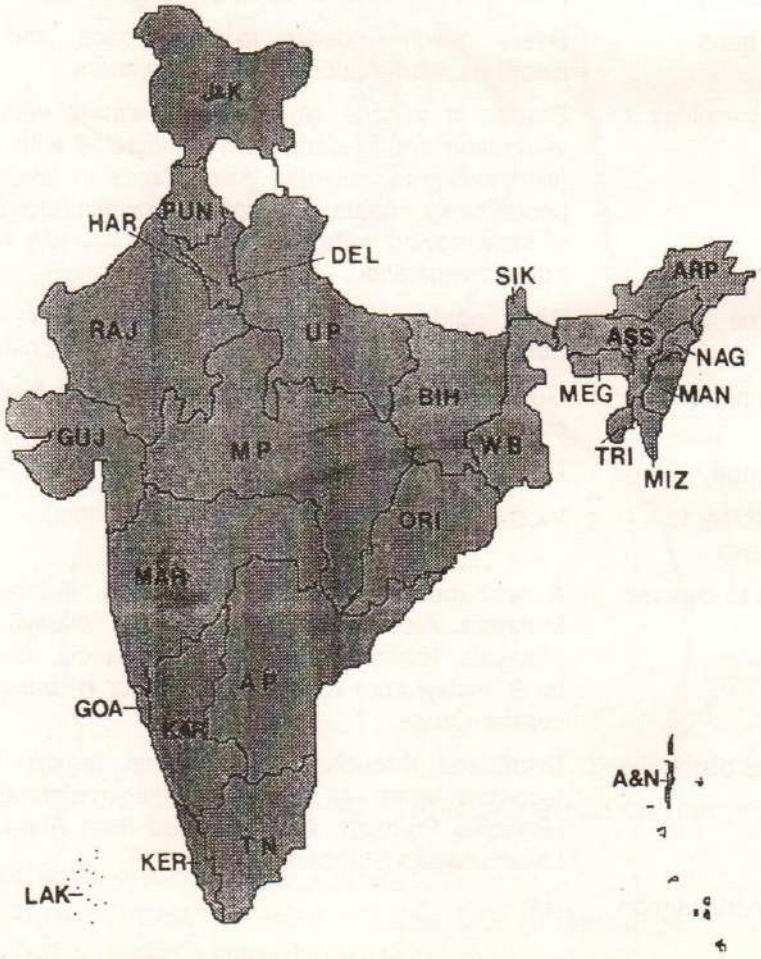
1. Palpi with 4 small pale bands
2. Basal dark area of vein 5 (CU) is 1/2 of the stem
3. Tarsomeres with broad bands

Anopheles nigerrimus

Name	:	*An. nigerrimus* Giles, 1900. *A Handbook of the Gnats or Mosquitoes giving the Anatomy and Life History of Culicidae*, 374 pages.
Old name	:	*An. sinensis* Wied (oriental).
Derivative	:	Latin, *niger,* black; *-imus,* superlative suffix. Giles gave this name because of the intensely black colour of the mosquito.
Type form	:	Available at the British Museum of Natural History, London.
Reported morphological variations	:	3 in maxillary palpi and 1 in wing
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Rests mainly indoors in cattlesheds and human dwellings, also outdoors in good numbers.
Breeding ecology	:	Breeds in various types of still waters with aquatic vegetation and is particularly associated with ricefields (with well-grown plants). Also breeds in lakes, grassy pools, tanks, moats, swamps, borrowpits, drains, edges of slow-moving waters, shady ponds, usually with good aquatic vegetation.
Biting time	:	Bites outdoors and indoors and usually at dusk. Sometimes bites in day time during full sunshine.
Feeding preference	:	Generally recognized as a zoophilic but also feeds readily on man.
Flight range	:	Up to 1 km.
Susceptibility to insecticides	:	Incipient resistance to DDT in Orissa (India).
Relation to disease	:	A well-known vector of malaria in Indonesia and Malaysia. Also transmits filariasis (*B. malayi*) in India, Malaysia, Thailand, and Sri Lanka. In India, incriminated for *B. malayi* from West Bengal and for *W. bancrofti* from coastal Orissa.
Reported distribution	:	Distributed throughout the oriental region. In India, recorded from all parts of the mainland except Himachal Pradesh. Also recorded from Andaman and Lakshadweep Islands.
Vector incrimination	:	NA



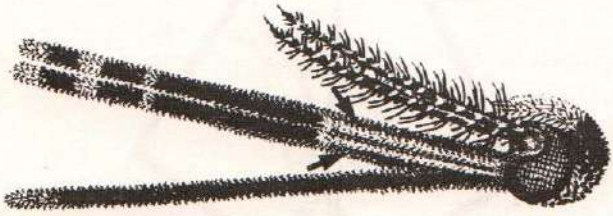
Reported distribution of *An. nigerrimus* in the World.

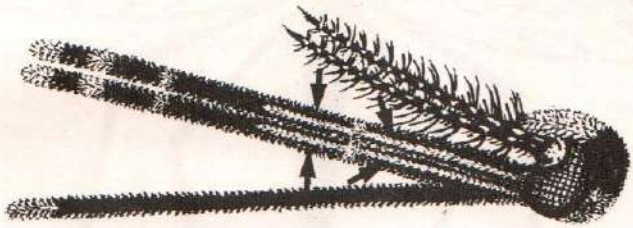


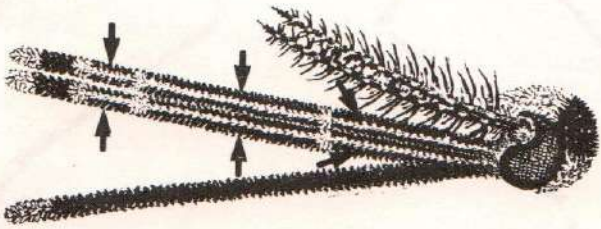
Reported distribution of *An. nigerrimus* in India.

REPORTED IMPORTANT VARIATIONS OF *An. nigerrimus*

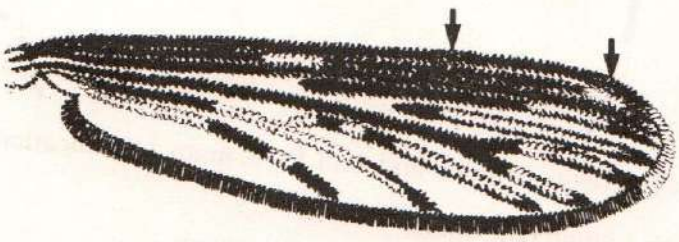
Variations in palpi

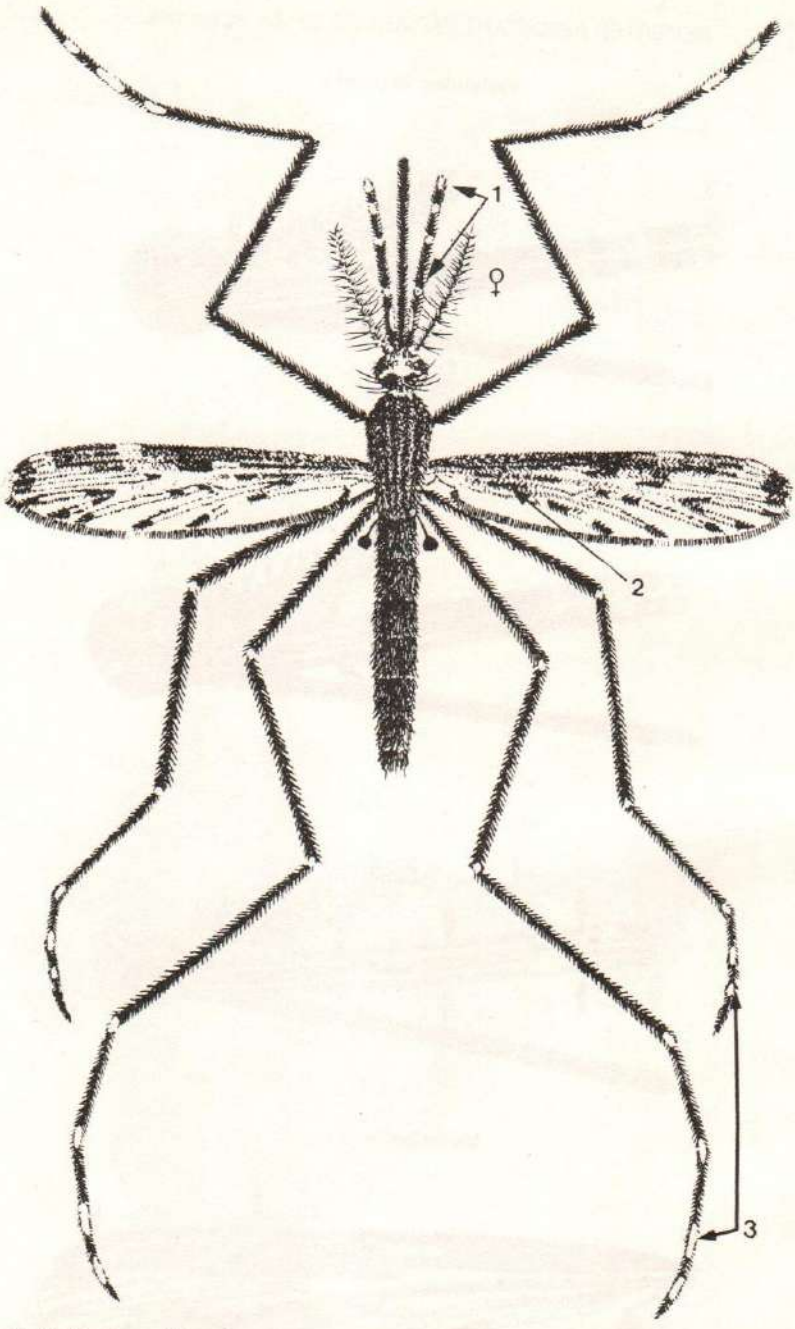






Variation in wing



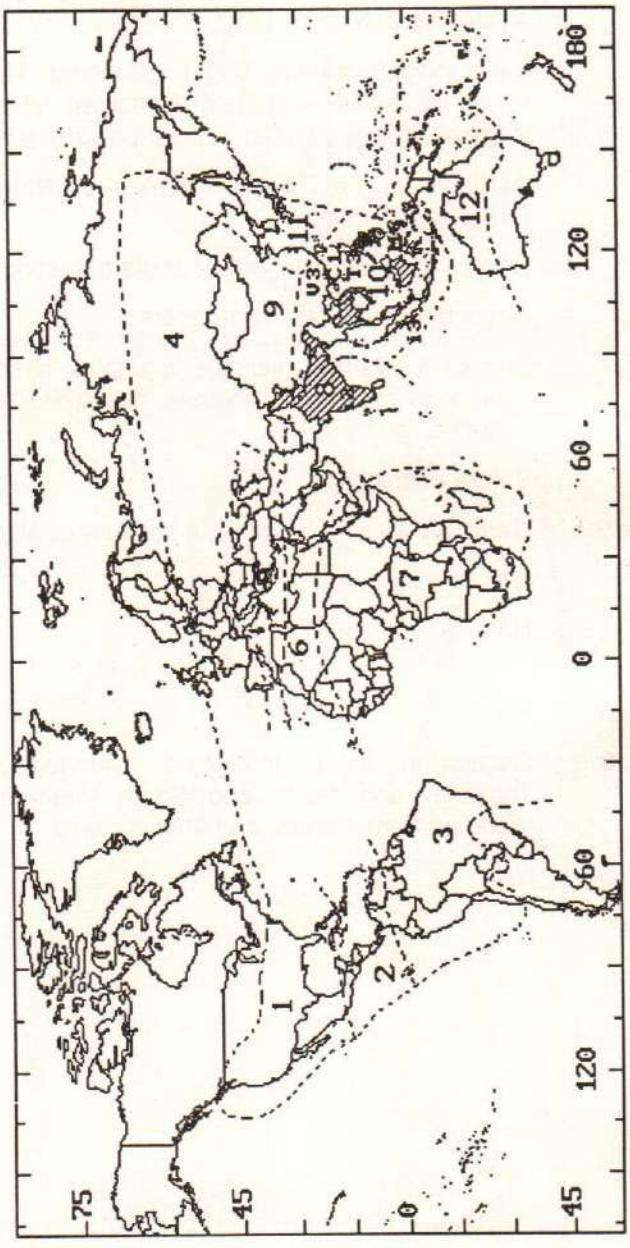


An. nitidus Harrison, Scanlon and Reid 1973, main identification characters

1. Palpi with 4 small pale bands
2. Basal dark area of vein 5 (CU) is 1/4 of the stem
3. Tarsomeres with broad bands

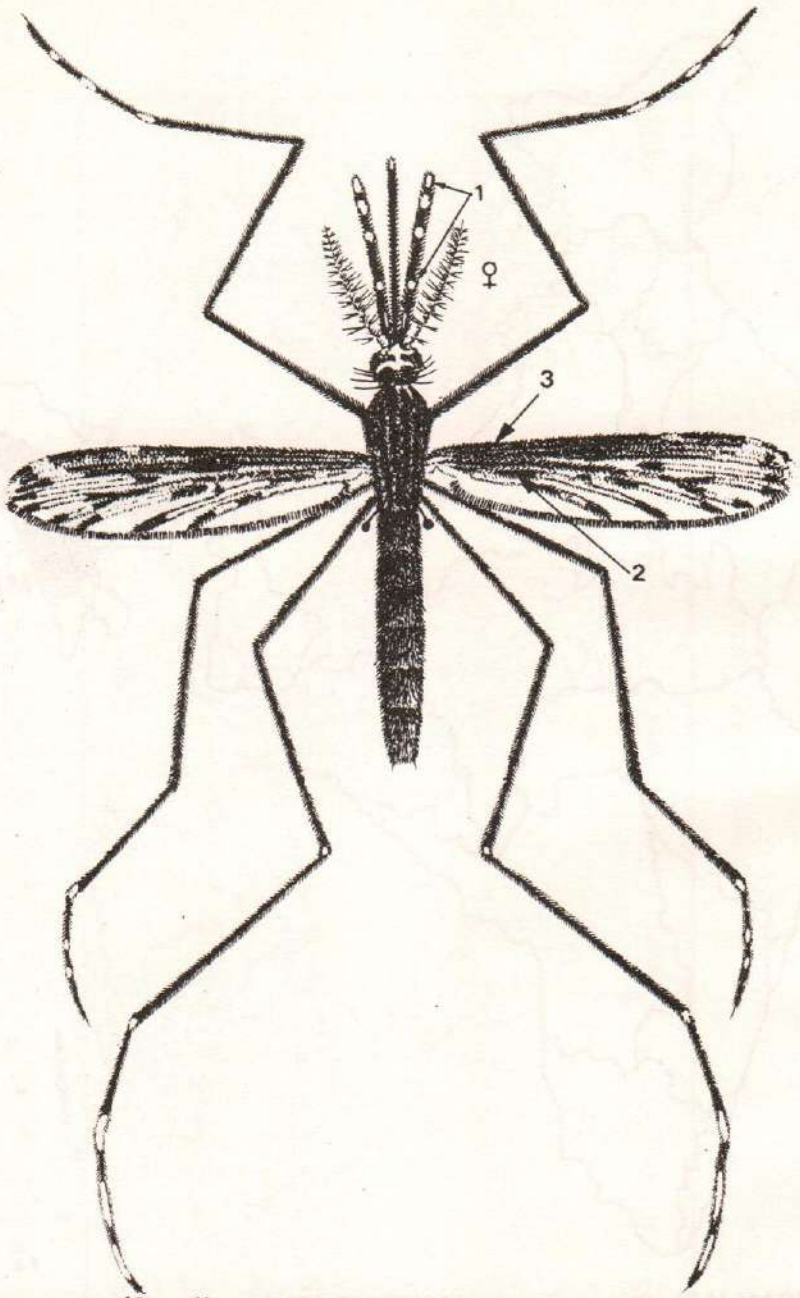
Anopheles nitidus

Name	:	*An. nitidus* Harrison, Scanlon and Reid, 1973. *Mosquito Systematics*, **5**: 263–268.
Derivative	:	Latin, *nitidus*, shining, bright, glistening. This is a new name for *indiensis* of Reid. Renamed *nitidus* owing to the presence of elegant, neat, bright, sharp wing pattern.
Type form	:	Available at the British Museum of Natural History, London.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Rests both indoors and outdoors.
Breeding ecology	:	Breeds in swamps, marshes in jungles, seepages, large mine pits, rock pools, ditches, ricefields, and elephant footprints in the forest.
Biting time	:	Before midnight.
Feeding preference	:	Generally a cattle feeder, but sometimes also bites man.
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	NA
Reported distribution	:	Occurs in India, Indonesia, Cambodia, Malaysia, Thailand, and North and South Vietnam. In India, recorded from Assam, and Manipur only.
Vector incrimination	:	NA



Reported distribution of *An. nitidus* in the World.

Reported distribution of *An. nitidus* in India.

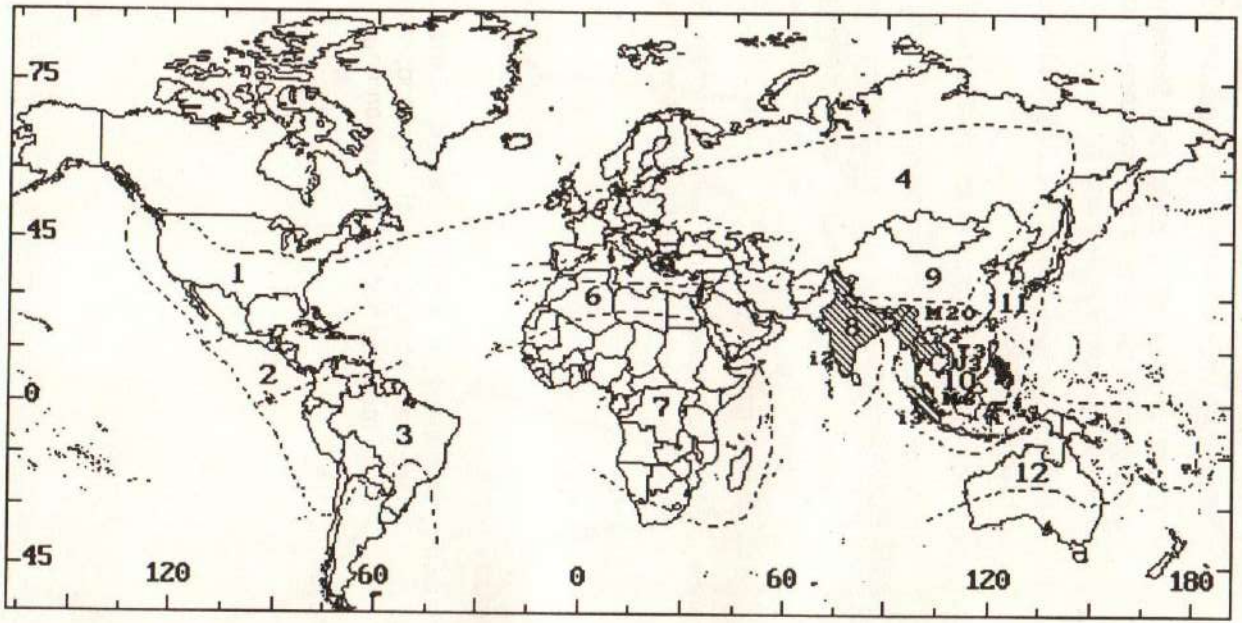


An. argyropus (Swellengrebel) 1914, main identification characters

1. Palpi with 4 small pale bands
2. Basal dark area of vein 5 (CU) is 3/4 of the stem
3. Inner costa completely dark

Anopheles argyropus

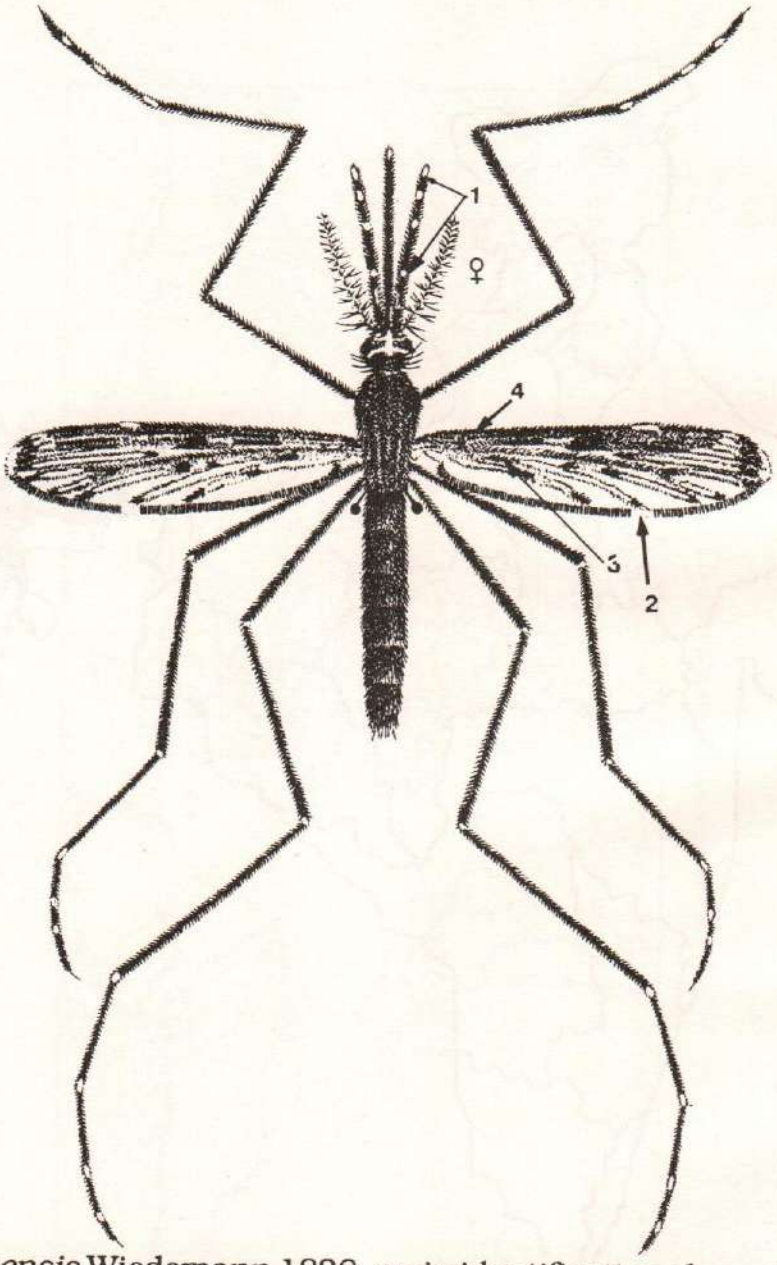
Name	:	*An. argyropus* (Swellengrebel), 1914. *Geneeskundig Tijdschrift Voor Nederlandsch, Indië*, **54:** 334–337.
Derivative	:	Greek, *argyros*, silver; *pous*, foot. Swellengrebel named it *argyropus* because of the presence of white markings on hind tarsomeres 3, 4 and 5.
Type form	:	Plesiotypes available at the British Museum of Natural History, London.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Rests in houses and cattlesheds. Outdoor resting also recorded.
Breeding ecology	:	Breeds in ricefields and large deep swamps with vegetation.
Biting time	:	Before midnight.
Feeding preference	:	Attracted more towards cattle than man. Specimens can also be collected in good numbers with the light trap.
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	NA
Reported distribution	:	Distributed in India, Indonesia, Cambodia, Malaysia, Myanmar, Malaya (Java), Thailand, and Vietnam. In India, recorded from Assam region only.
Vector incrimination	:	NA



Reported distribution of *An. argyropus* in the World.

ASSAM (ASS)
1. Kamrup

Reported distribution of *An. argyropus* in India.

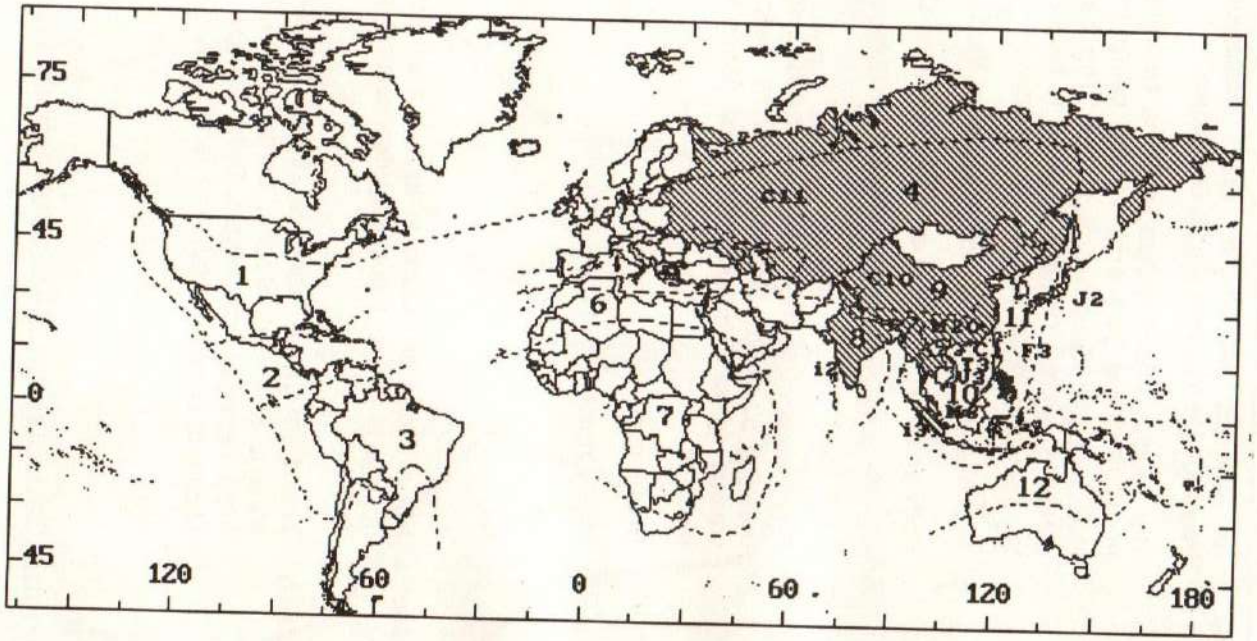


An. sinensis Wiedemann 1828, main identification characters

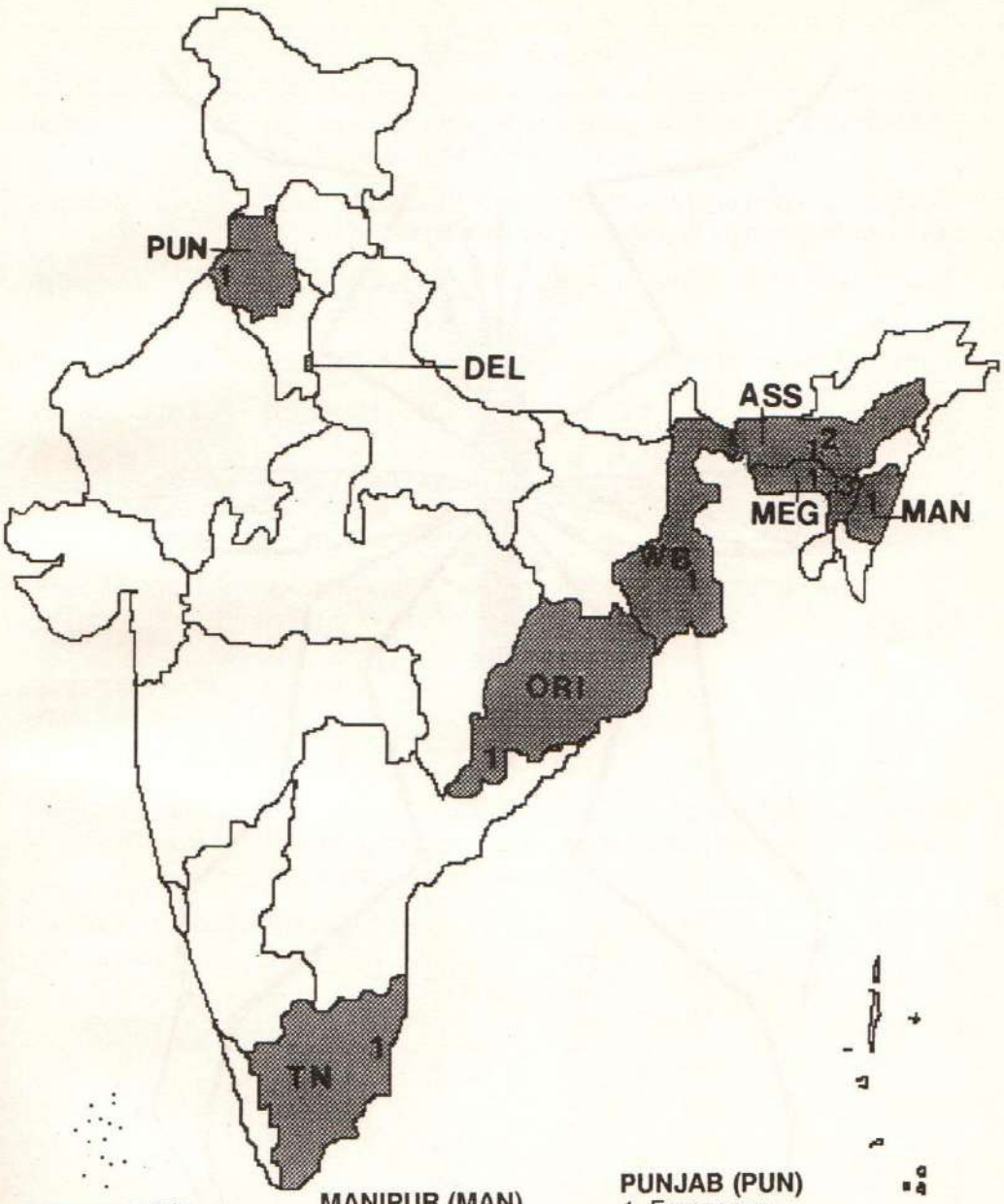
1. Palpi with 4 small pale bands
2. Fringe spot on vein 5.2 (CU2)
3. Basal dark area of vein 5 (CU) is 1/6 of the stem
4. Inner costa completely dark

Anopheles sinensis

Name	:	*An. sinensis* Wiedemann, 1828. *Aussereuropäische Zweiflugelige Insekten*, vol. 1, 608 pages
Derivative	:	The species was collected in China by Wiedemann's friend Dr. Trentepohl from various points in the Far East including Canton and Macao. The Latin *Sinae* (Greek *Sinai*), the Chinese, appears to be the base for Wiedemann's locative adjective, *sinensis*.
Type form	:	Available at the Natural History Museum, Vienna, Austria.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Regarded as exophilic but also rests in human dwellings and cattlesheds.
Breeding ecology	:	Ricefields are the most important breeding sites. Other breeding places are marshes, streams, seepages, and various types of ground pools and ponds with water hyacinth.
Biting time	:	Before midnight.
Feeding preference	:	Highly zoophilic but bites man also.
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	Not a vector of malaria in India but a main vector of malaria in China, Indochina, Indonesia, Myanmar, and Taiwan.
Reported distribution	:	Found in China, Formosa, India, Indonesia, Japan, Malaya, Myanmar, Siberia, Sumatra, and Thailand. In India, recorded from Assam, Delhi, Manipur, Meghalaya Mizoram, Orissa, Punjab, and Tamil Nadu.
Vector incrimination	:	NA



Reported distribution of *An. sinensis* in the World.



ASSAM (ASS)
1. Kamrup
2. Nalabari
3. Cachar

DELHI (DEL)
1. Delhi

MANIPUR (MAN)
1. Imphal

MEGHALAYA (MEG)
1. Shillong

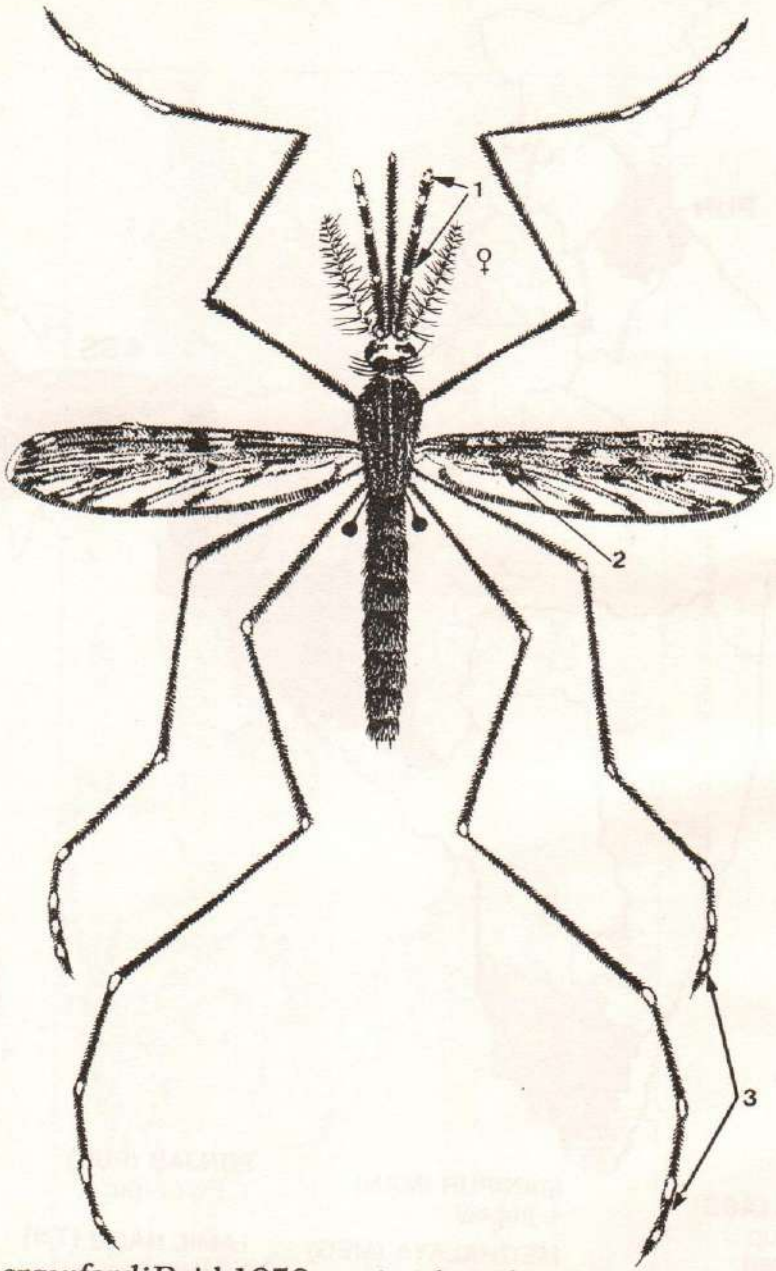
ORISSA (ORI)
1. Koraput

PUNJAB (PUN)
1. Ferozepur

TAMIL NADU (TN)
1. Madras

WEST BENGAL (WB)
1.Calcutta

Reported distribution of *An. sinensis* in India.

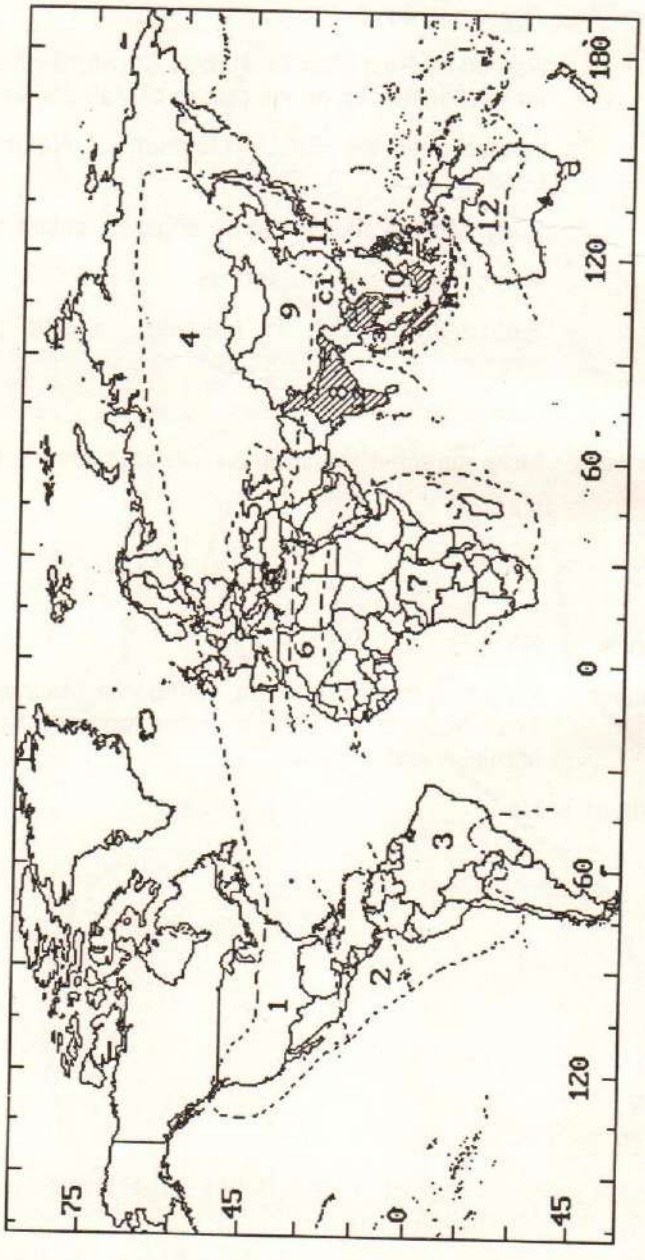


An. crawfordi Reid 1953, main identification characters

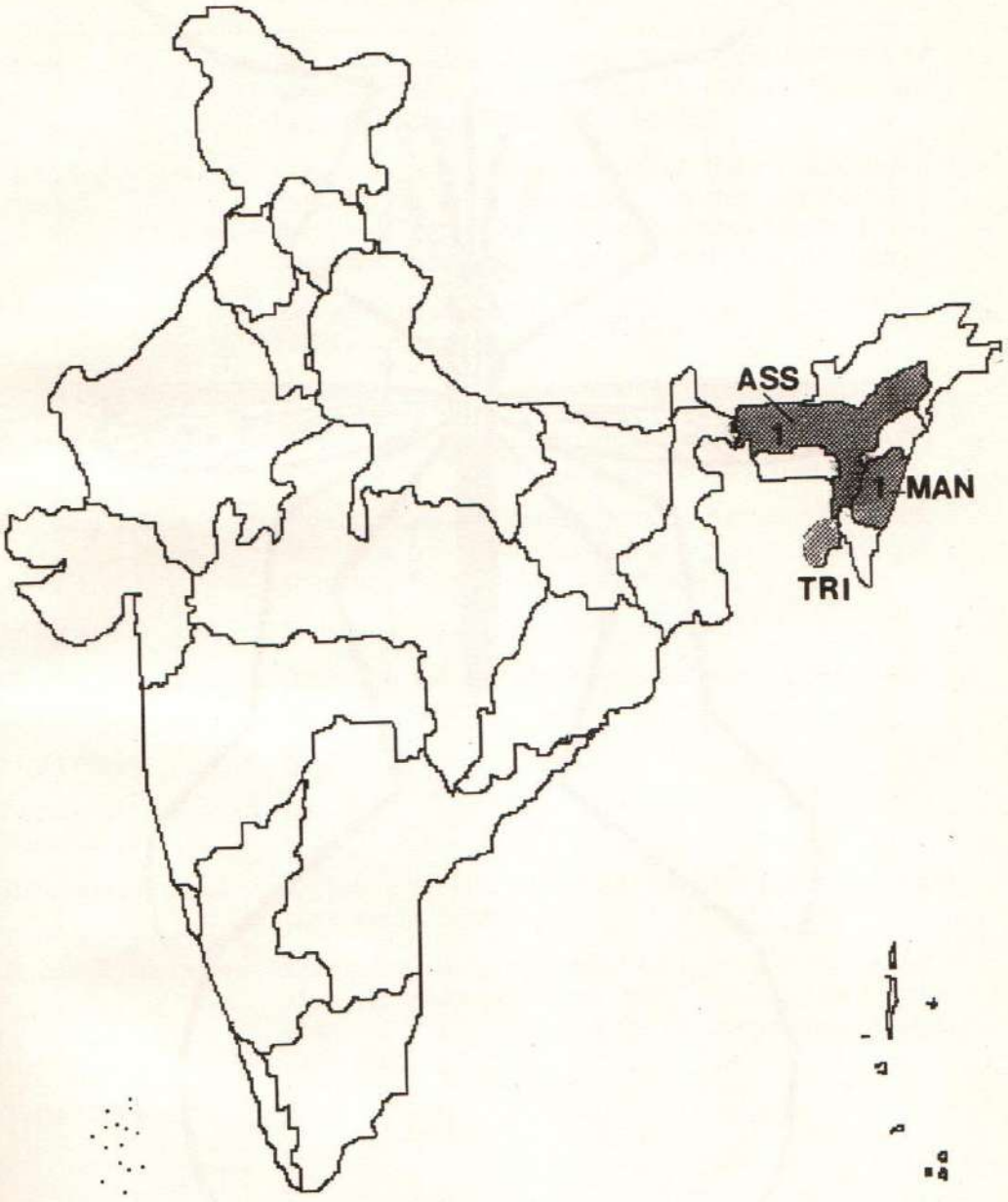
1. Palpi with 4 pale small bands
2. Basal dark area of vein 5 (CU) is 1/6 of the stem
3. Tarsomeres with broad bands

Anopheles crawfordi

Name	:	*An. crawfordi* Reid, 1953. *Bulletin of Entomological Research*, **44:** 5–76.
Derivative	:	Named by Reid after Dr. Robert Crawford who published an excellent work on the pupae of Malayan anophelines.
Type form	:	Available at the British Museum of Natural History, London.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Rests outdoors in wet forests.
Breeding ecology	:	Particularly breeds in marshes, ground pools and swamps.
Biting time	:	Before midnight.
Feeding preference	:	More attracted to man than monkeys and cattle.
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	NA
Reported distribution	:	Occurs in India, Indonesia, Cambodia, Malaya, Malaysia, Thailand, and Vietnam. In India, recorded from Assam, Manipur, and Tripura.
Vector incrimination	:	NA



Reported distribution of *An. crawfordi* in the World.

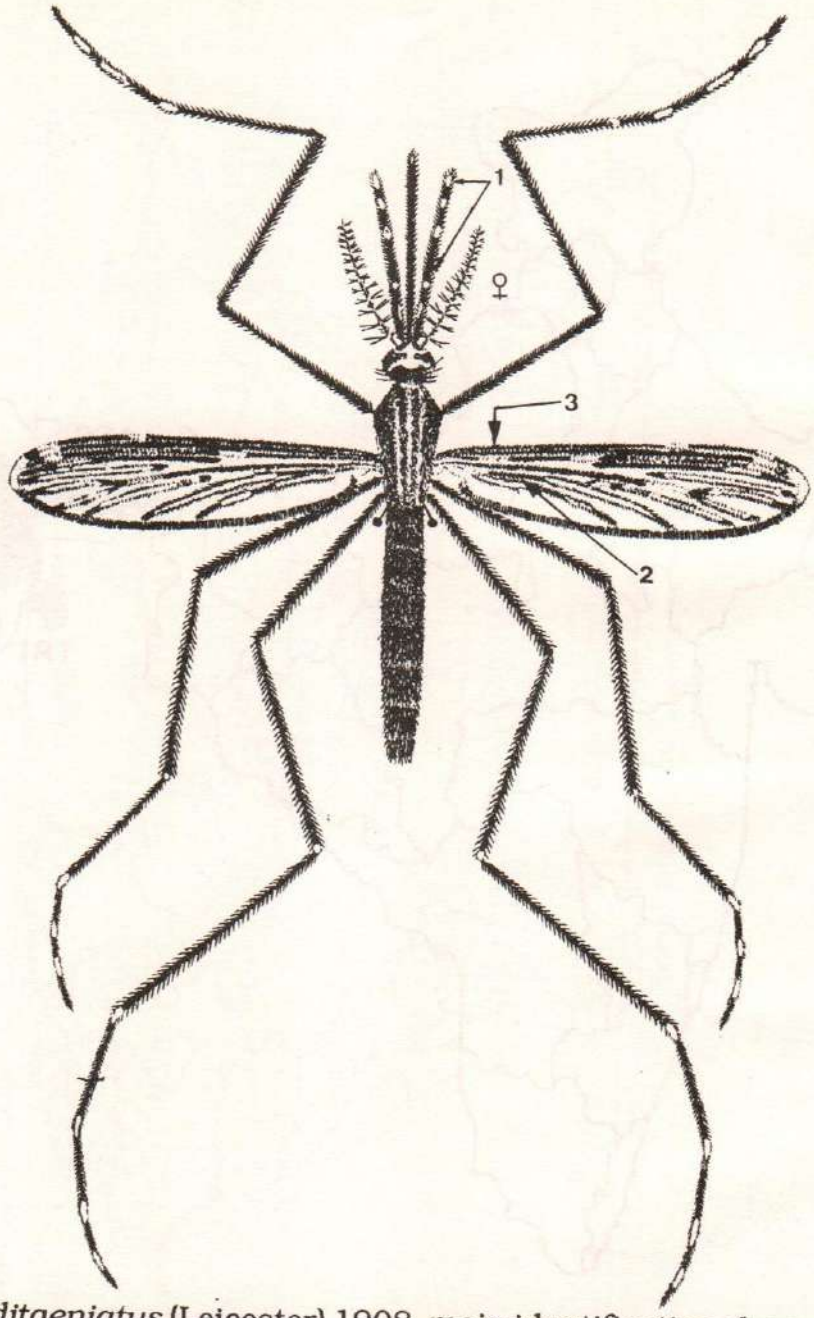


ASSAM (AS)
1. Kamrup

MANIPUR (MAN)
1. Imphal

TRIPURA (TRI)
1. Agartala

Reported distribution of *An. crawfordi* in India.

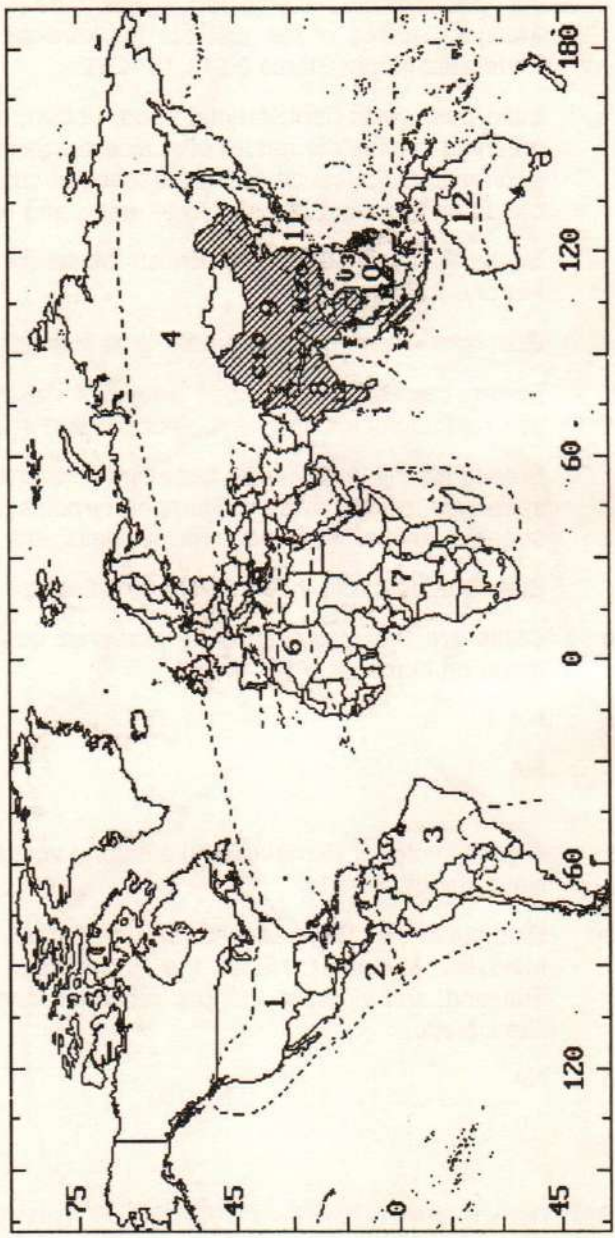


An. peditaeniatus (Leicester) 1908, main identification characters

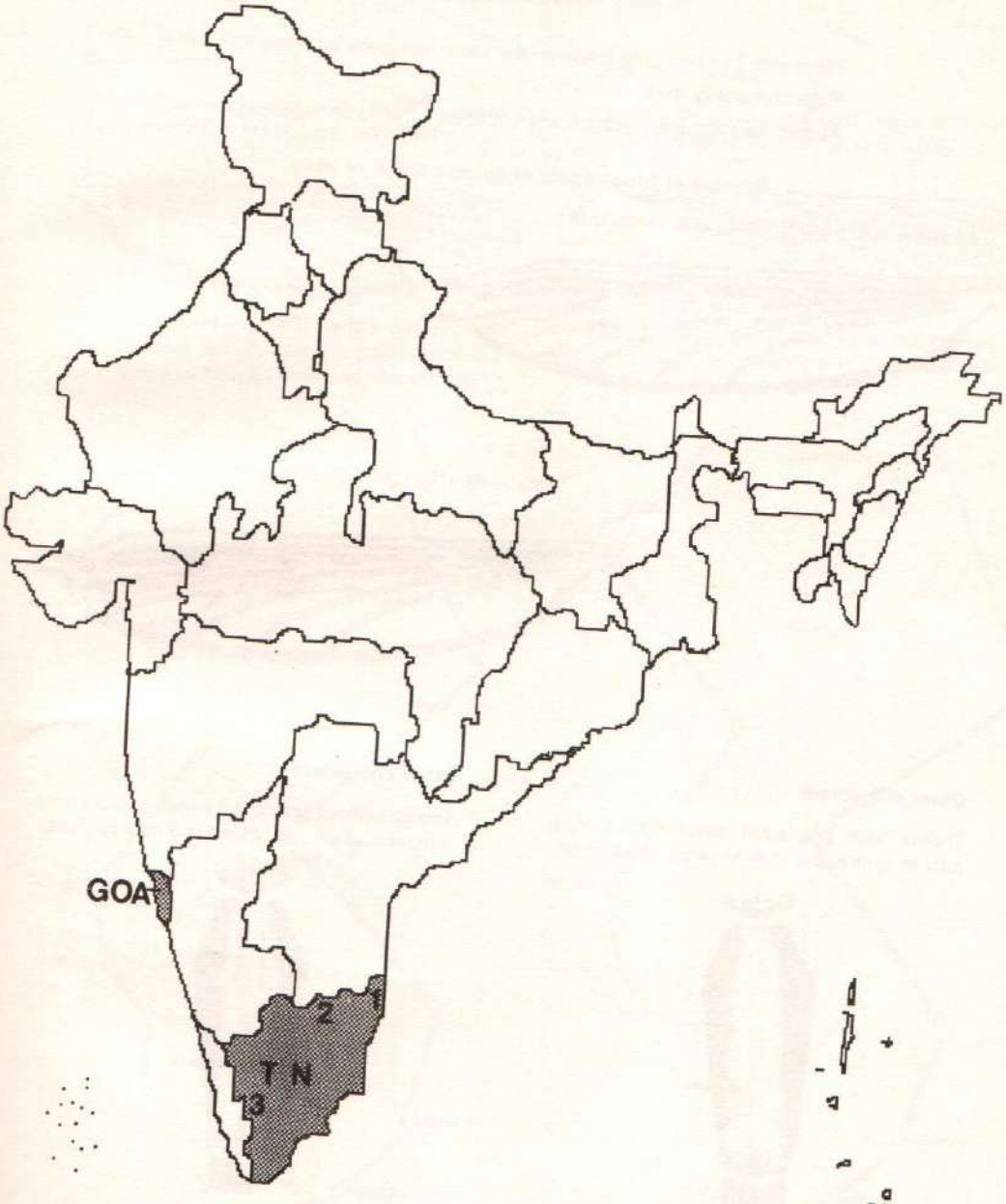
1. Palpi with 4 small pale bands
2. Basal dark area of vein 5 (CU) is 1/3 of the stem
3. Inner costa completely dark

Anopheles peditaeniatus

Name	:	*An. peditaeniatus* (Leicester), 1908. *The Culicidae of Malaya.* Studies of the Institute for Medical Research. Federated Malay States **3 (3):** 18–261.
Derivative	:	Latin *pes, pedis*, foot; *taenia*, band, ribbon; *atus*, suffix, meaning 'having the nature of'. Leicester gave the name *peditaeniatus* because of the presence of creamy yellow bands on the metatarsus of fore-, mid-, and hind legs.
Type form	:	Syntypes available at the British Museum of Natural History, London.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Prefers cattlesheds to human dwellings. Adults collected at an altitude of 570 m in Sri Lanka and 540 m in Thailand.
Breeding ecology	:	Breeds mainly in ricefields, but also in marshes, ditches, seepages, ponds, swamps, temporary pools, margins of streams, animal footprints, shallow wells, etc.
Biting time	:	Bites outdoors and indoors before midnight.
Feeding preference	:	Cattle are the overwhelmingly preferred host, but also feeds on humans.
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	A good vector of *B. malayi* and a natural vector of animal filaria genus *Setaria*.
Reported distribution	:	Distributed in Bangladesh, China, India, Indonesia, Malaysia, Myanmar, Nepal, the Philippines, Sri Lanka, Thailand, and Vietnam. In India, recorded from Goa, and Tamil Nadu.
Vector incrimination	:	NA



Reported distribution of *An. peditaeniatus* in the World.



GOA - UT (GOA)
1. Goa

TAMIL NADU (TN)
1. Madras
2. North Arcot
3. Western Ghat

Reported distribution of *An. peditaeniatus* in India.

2.5. An. umbrosus, An. roperi

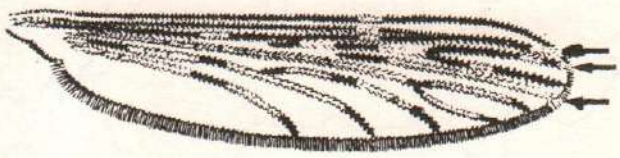
Wing with 3 or less pale areas on the costa, subcosta including vein 1(R1)
Palpi completely dark
Abdominal segment 7 without any tuft of dark scales on venter side

Number of fringe spots at apical portion of wing

Two veins 1(R1) and 3(R4+5) with fringe spot

An. umbrosus

Three veins 1(R1), 2.1(R2) and 3(R4+5) with fringe spot



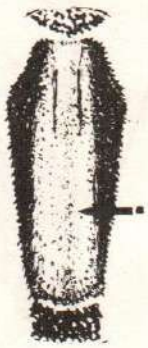
An. roperi

Other characters

Thorax with propleural setae (mesonotum pale in centre and dark towards lateral side)

Other characters

Thorax without propleural setae (mesonotum with mottled pattern of light and dark patches)

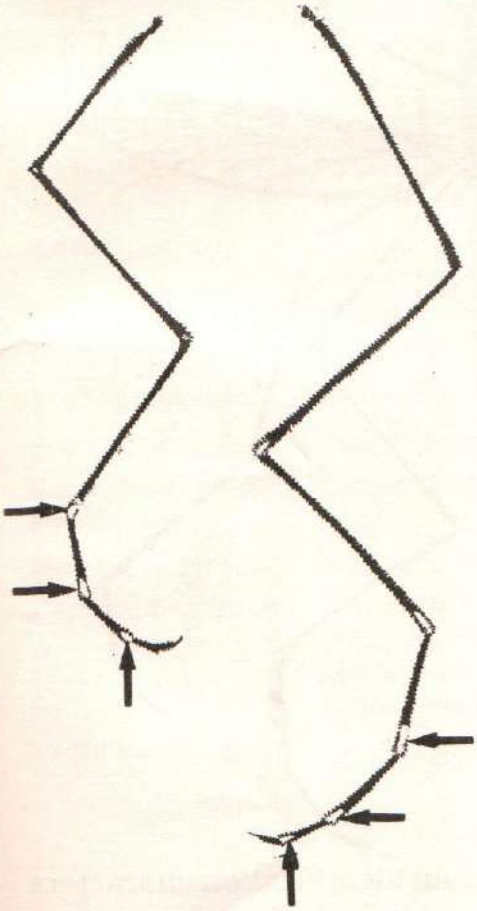


An. umbrosus, An. roperi

Other characters

Extreme base of costa and bases of veins 1(R1) and 5(Cu) without any pale scales

Foreleg tarsomeres with narrow apical pale bands; Hind tarsomeres with pale bands up to 3 times as long as wide and above joints

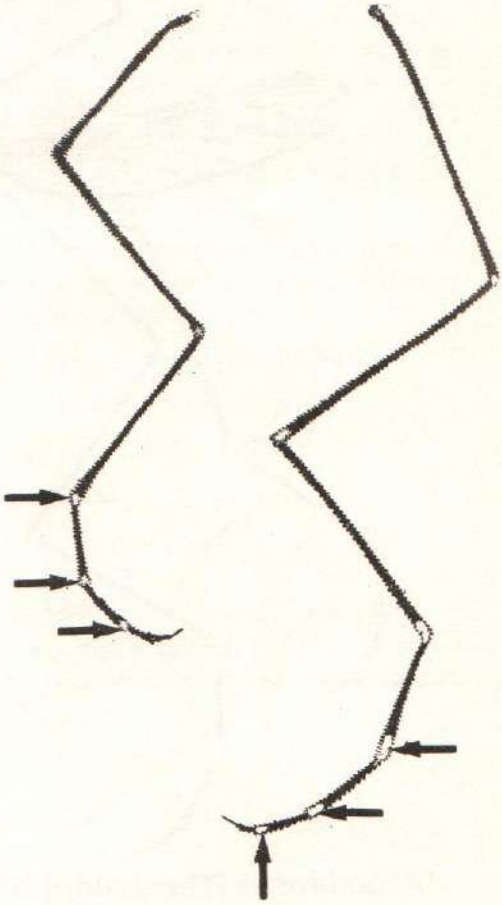


An. umbrosus

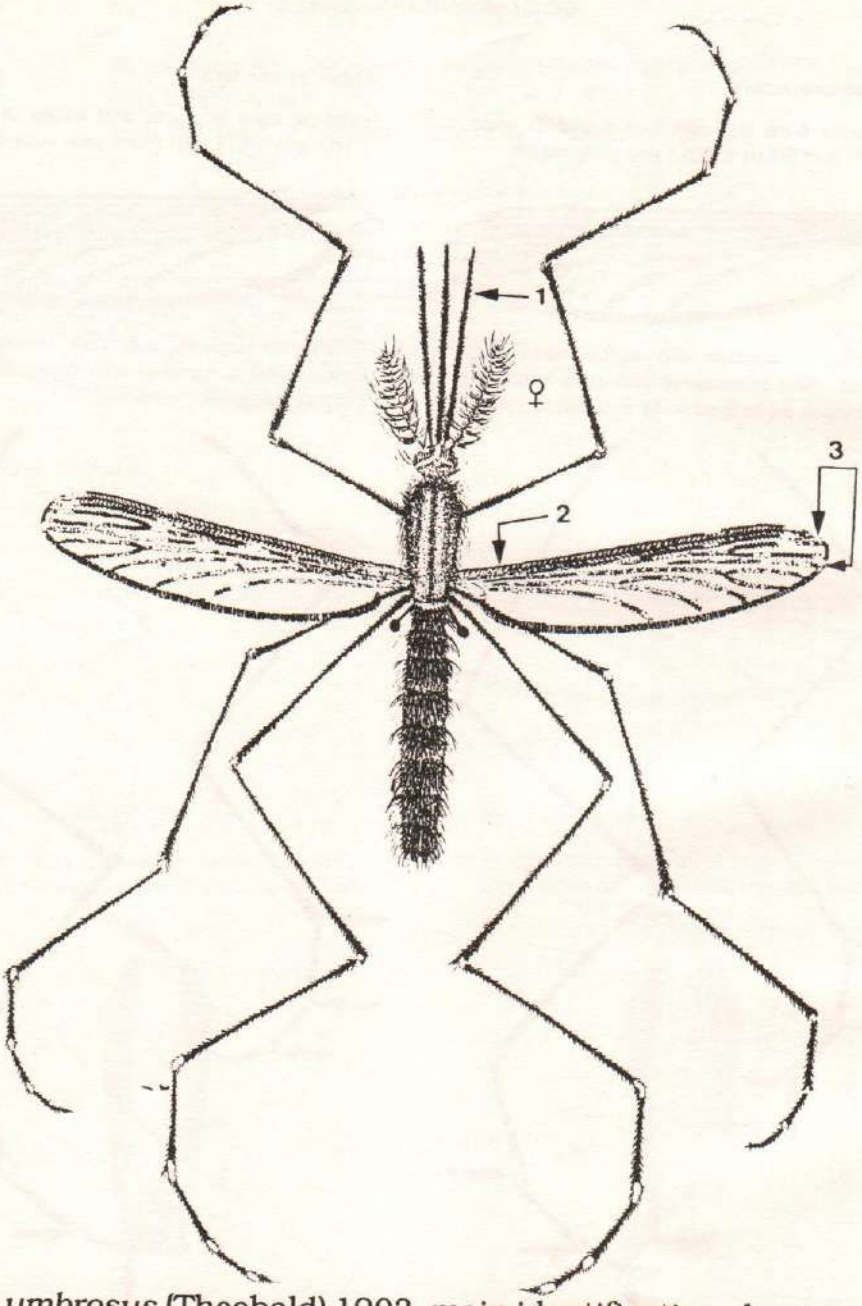
Other characters

Extreme base of costa and bases of veins 1(R1) and 5(Cu) with some pale scales

Foreleg tarsomeres with very minute pale bands; Hind tarsomeres with third pale band lying across joints



An. roperi

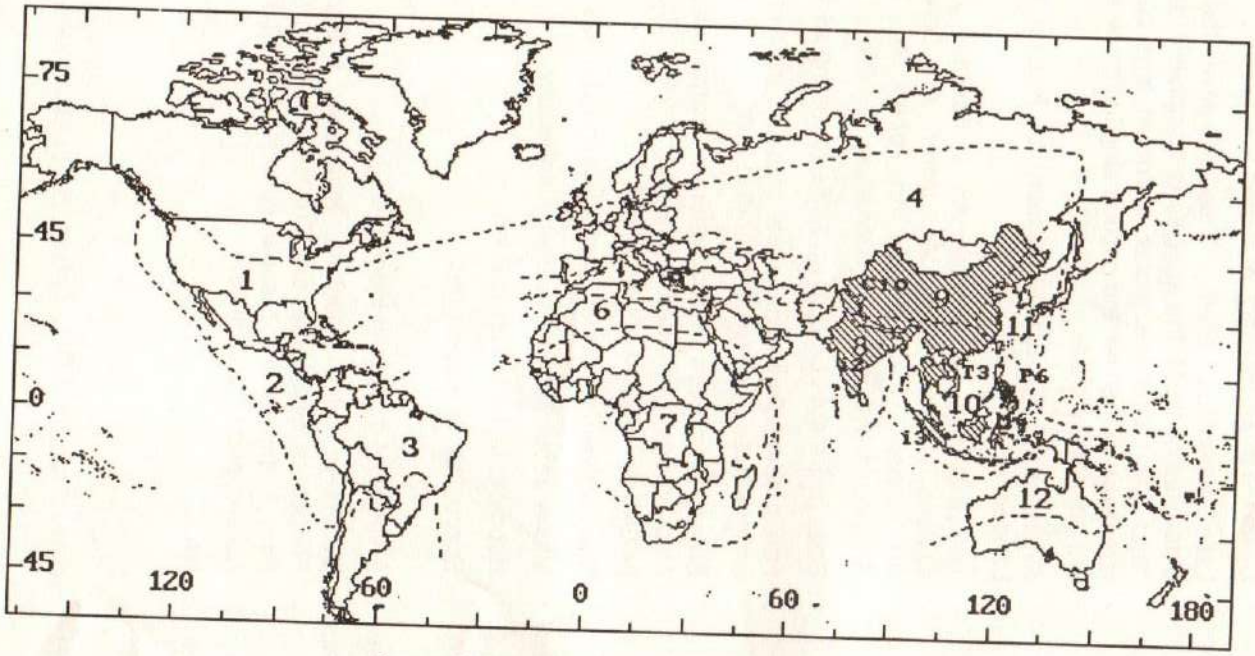


An. umbrosus (Theobald) 1903, main identification characters

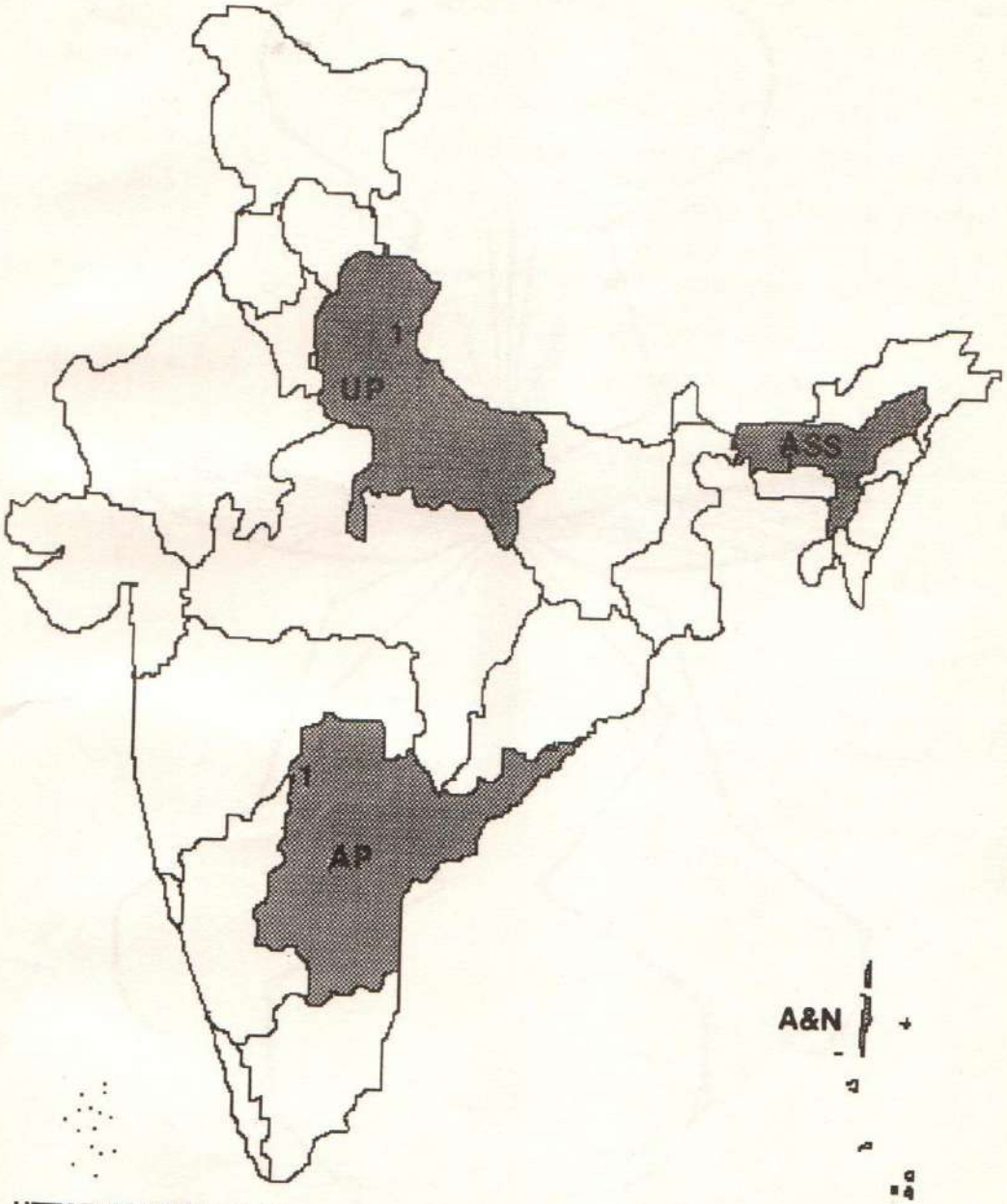
1. Palpi completely dark
2. Inner costa completely dark
3. Fringe spot on veins 1 (R1) and 3(R4+5)

Anopheles umbrosus

Name	:	*An. umbrosus* (Theobald), 1903. *A Monograph of the Culicidae or Mosquitoes*, **3:** 87–88.
Derivative	:	Latin, *umbrasus*, shady. Theobald gave the name *umbrosus* because the species is completely dark, i.e. head, palpi, antennae, thorax, abdomen, legs, costa and remainder of the first and second longitudinal wing veins are completely black.
Type form	:	Available at the British Museum of Natural History, London.
Species complex	:	Twelve species (*An. hunteri, An. sinilissimus, An. brevipalpis, An. separatus, An. letifer, An. brevirostris, An. umbrosus, An. baezai, An. roperi, An. collessi, An. whartoni*, and *An. albotaeniatus*).
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Forest species generally rests outdoors in forest areas under shrubs; also rests indoors in huts.
Breeding ecology	:	Breeds in stagnant shallow waters in swamp forest areas. Also breeds in shaded pools and running streams of jungles in Thailand and Malaysia.
Biting time	:	Bites actively throughout the day in forest areas.
Feeding preference	:	Mainly zoophilic but also bites man readily.
Flight range	:	Reported dispersal up to 2 km.
Susceptibility to insecticides	:	Susceptible to insecticides.
Relation to disease	:	A vector of malaria in Indonesia.
Reported distribution	:	Occurs in India, Indochina, Indonesia, Malaysia, the Philippines, Singapore, and Thailand. In India, recorded from Andaman and Nicobar Islands, Andhra Pradesh, Assam, and Uttar Pradesh.
Vector incrimination	:	NA



Reported distribution of *An. umbrosus* in the World.



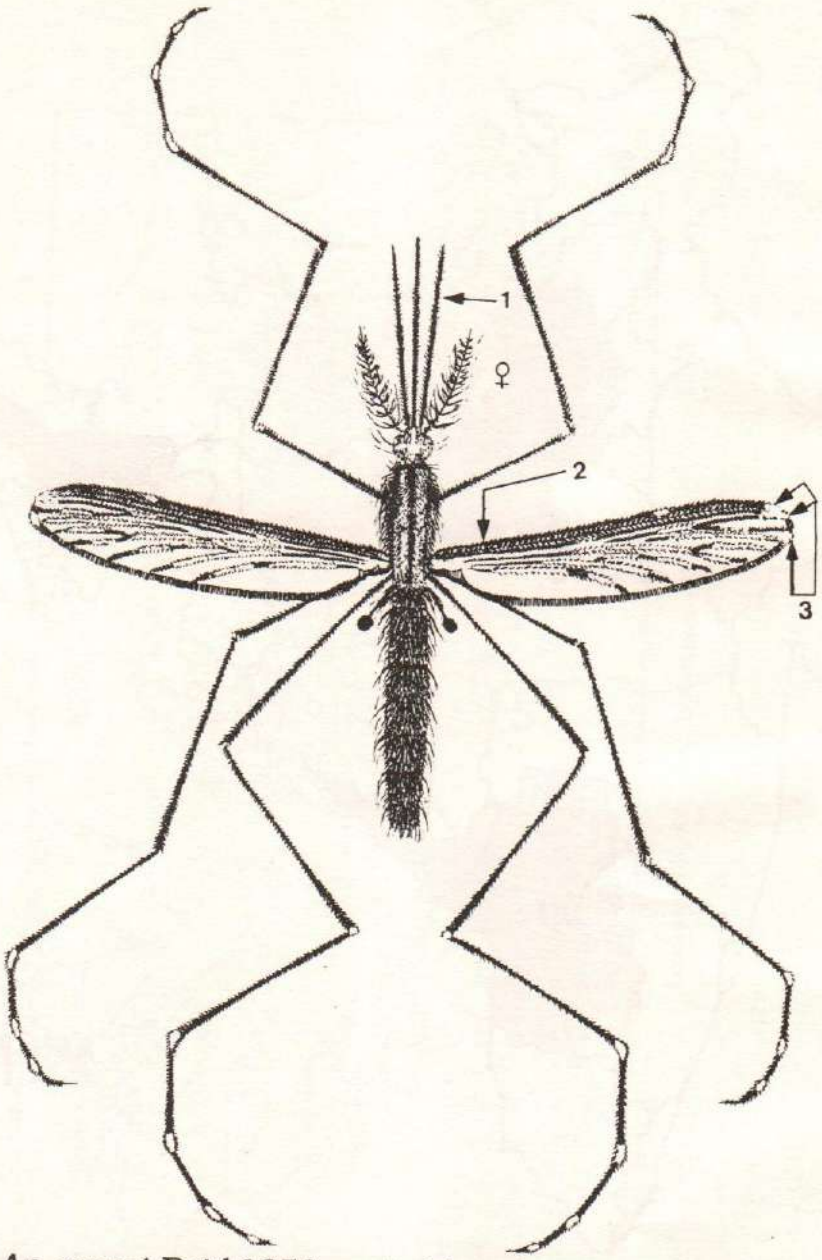
UTTAR PRADESH (UP)
1. Nainital

ANDHRA PRADESH (AP)
1. Nizamabad

ANDAMAN NICOBAR ISLANDS (A&N)
1. Andaman Islands

ASSAM (ASS)
1. Kamrup

Reported distribution of *An. umbrosus* in India.

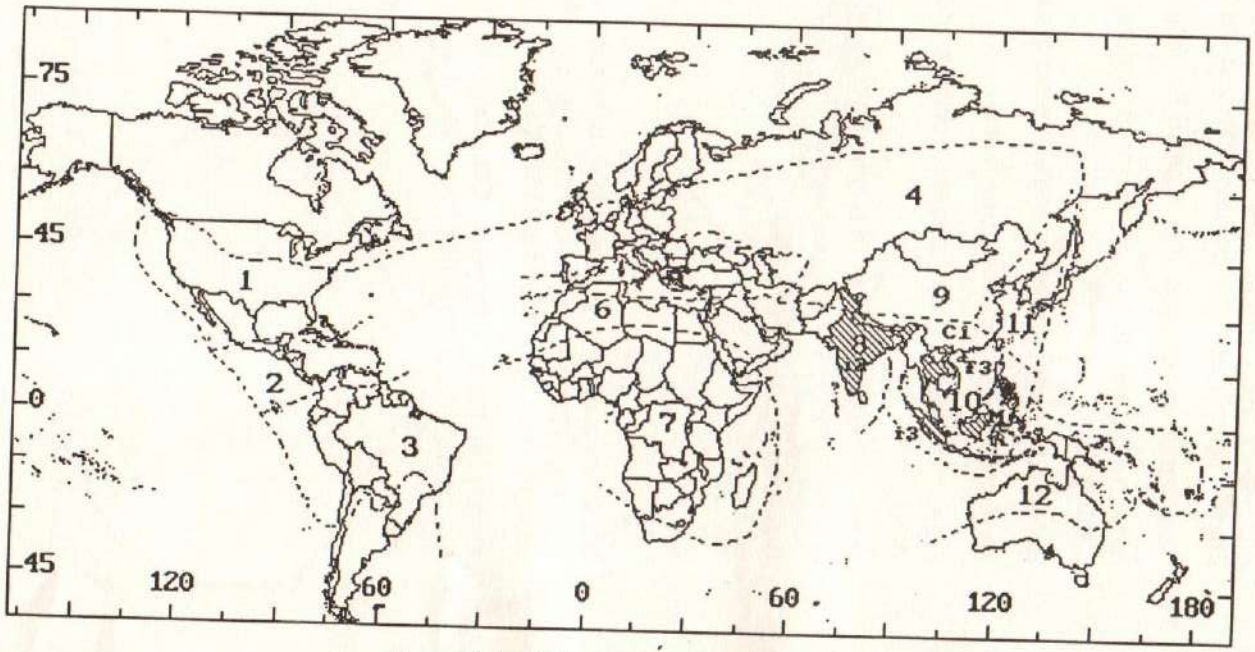


An. roperi Reid 1950, main identification characters

1. Palpi completely dark
2. Inner costa completely dark
3. Fringe spot on veins 1 (R1), 2.1(R2)

Anopheles roperi

Name	:	*An. roperi* Reid, 1950. *Transactions of the Royal Entomological Society of London*, **101:** 281–318
Derivative	:	Reid named the species after Richard Snelling Roper.
Type form	:	Available at the British Museum of Natural History, London.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	An outdoor resting species (tree holes).
Breeding ecology	:	Breeds in shaded pools, swamps, ditches and flooded pools.
Biting time	:	In forests, bites outdoors throughout night and day with a peak in late evenings.
Feeding preference	:	Bites both monkeys and men.
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	No information is available about its relation to disease in India. However, natural infections of *Plasmodium* parasite have been found in Malaysia.
Reported distribution	:	Occurs in India, Indonesia, Cambodia, Malaysia, and Thailand. In India, collected from Assam only.
Vector incrimination	:	NA



Reported distribution of *An. roperi* in the World.

ASSAM (ASS)
1. Kamrup

Reported distribution of *An. roperi* in India.

2.6. An. ahomi, An. barbirostris, An. barbumbrosus

Wing with 3 or less pale areas on the costa, subcosta including vein 1(R1)
Palpi completely dark
Abdominal segment 7 with a tuft of dark scales on venter side

Size of apical fringe spot (fringe spot of wing vein 3(R4+5)); Scales on sternite 2–6 of abdominal segments

Wide at least from 3(R4+5) to 4.1(M1)

Scales absent on sternite

An. ahomi, An. barbumbrosus

Narrow, opposite vein 3(R4+5) only

Scales on sternite

An. barbirostris

An. ahomi, An. barbumbrosus

Fringe spot on vein 2.1(R2)

Absent

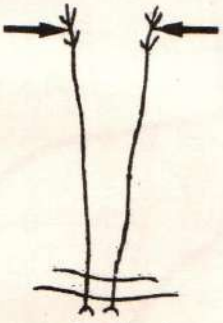
An. ahomi

Present

An. barbumbrosus

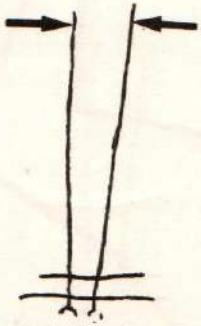
Both species can be confirmed by the inner clypeal hair on the head of larvae

Inner clypeal hair (2c; clypeal hair 2) with branches (12–36)

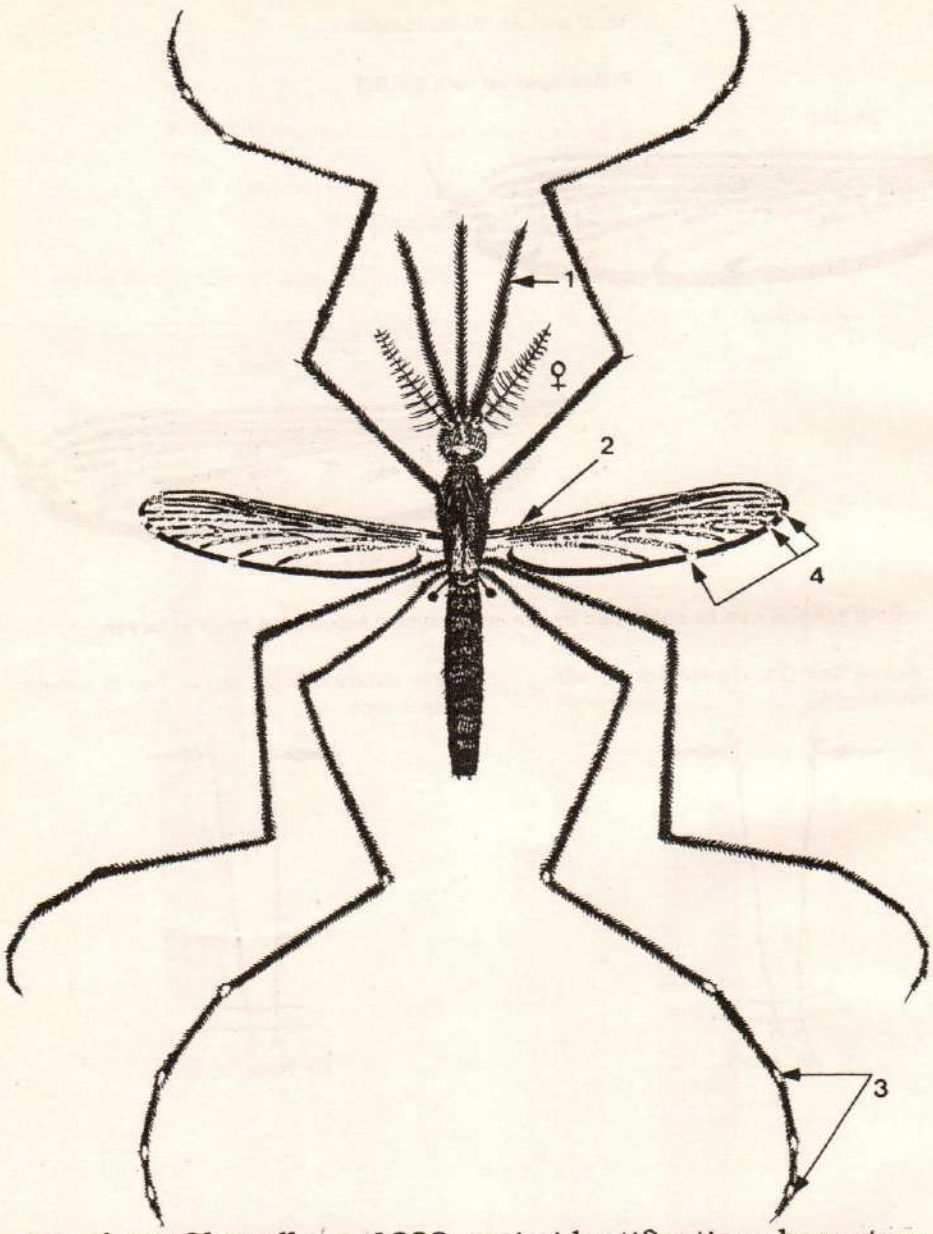


An. ahomi

Inner clypeal hair (2c; clypeal hair 2) without any branch



An. barbumbrosus



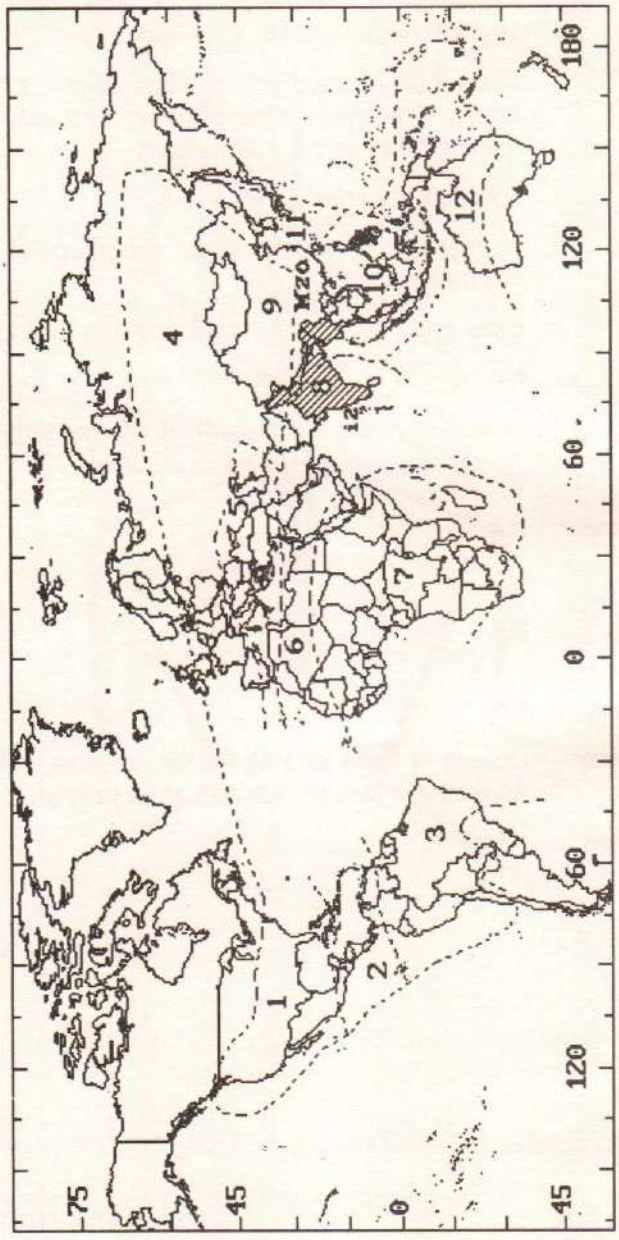
An. ahomi Chowdhury 1929, main identification characters

1. Palpi completely dark
2. Inner costa with pale scales
3. Hind leg tarsomeres with bands
4. Fringe spot on vein 3 (R4+5), 4.1 (M1) and 5.2 (CU2)

Further identification is based on larval characters

Anopheles ahomi

Name	:	*An. ahomi* Chowdhury, 1929. *The Indian Journal of Medical Research*, **16:** 986–988.
Derivative	:	Chowdhury named the species *ahomi* after Ahom or Aham, a powerful tribe of Shan descent, invaded the Assam valley in the 13th century.
Type form	:	Location not known.
Species complex	:	A member of *barbirostris* subgroup of *barbirostris* complex.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	NA
Breeding ecology	:	Breeds in pools and streams in tea gardens.
Biting time	:	NA
Feeding preference	:	NA
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	NA
Reported distribution	:	Occurs in India and Myanmar. In India, recorded from Arunachal Pradesh, Assam, and Manipur.
Vector incrimination	:	NA



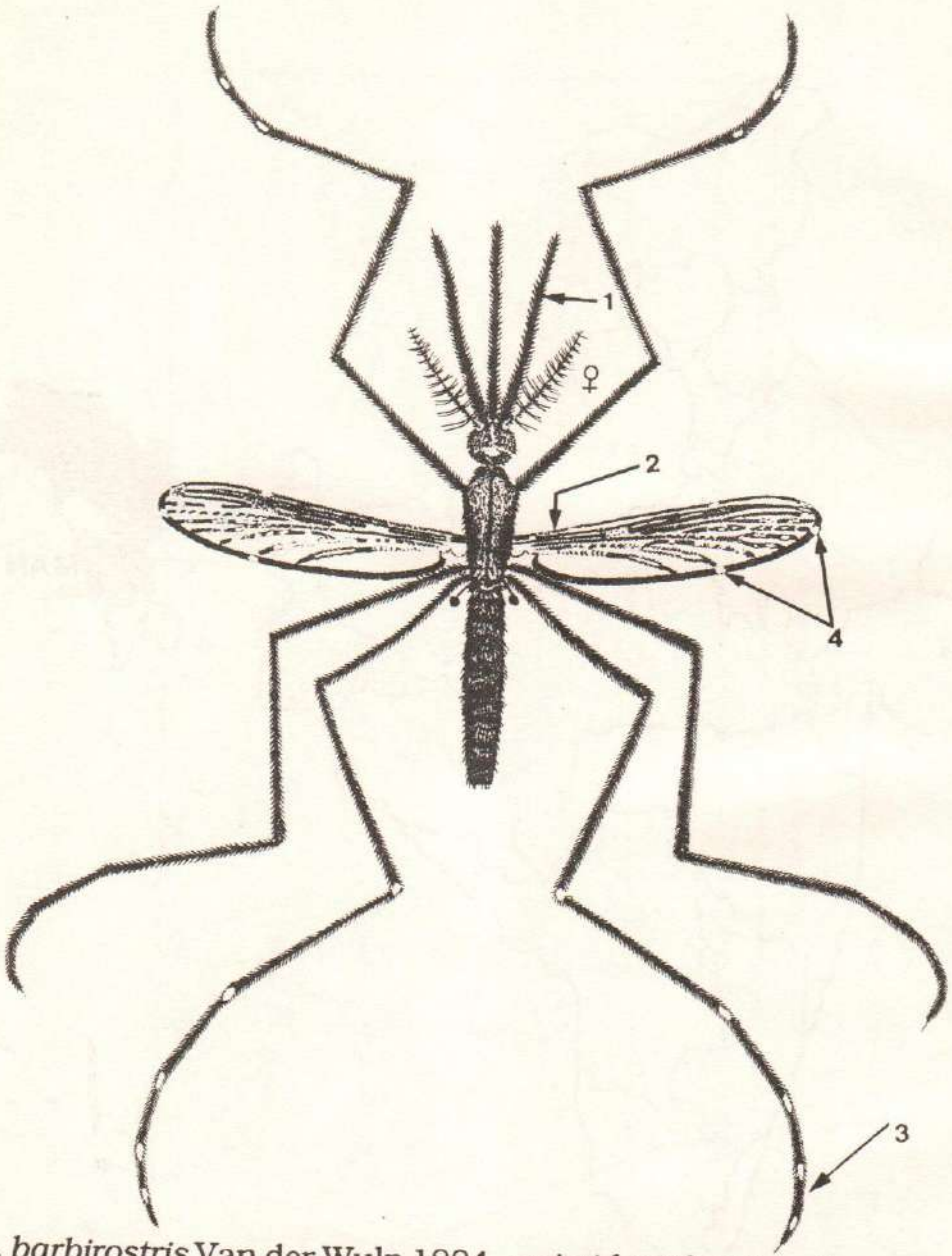
Reported distribution of *An. ahomi* in the World.

ARUNACHAL PRADESH (ARP)
1. East Kameng

ASSAM (ASS)
1. Lakhimpur

MANIPUR (MAN)
1. Imphal

Reported distribution of *An. ahomi* in India.



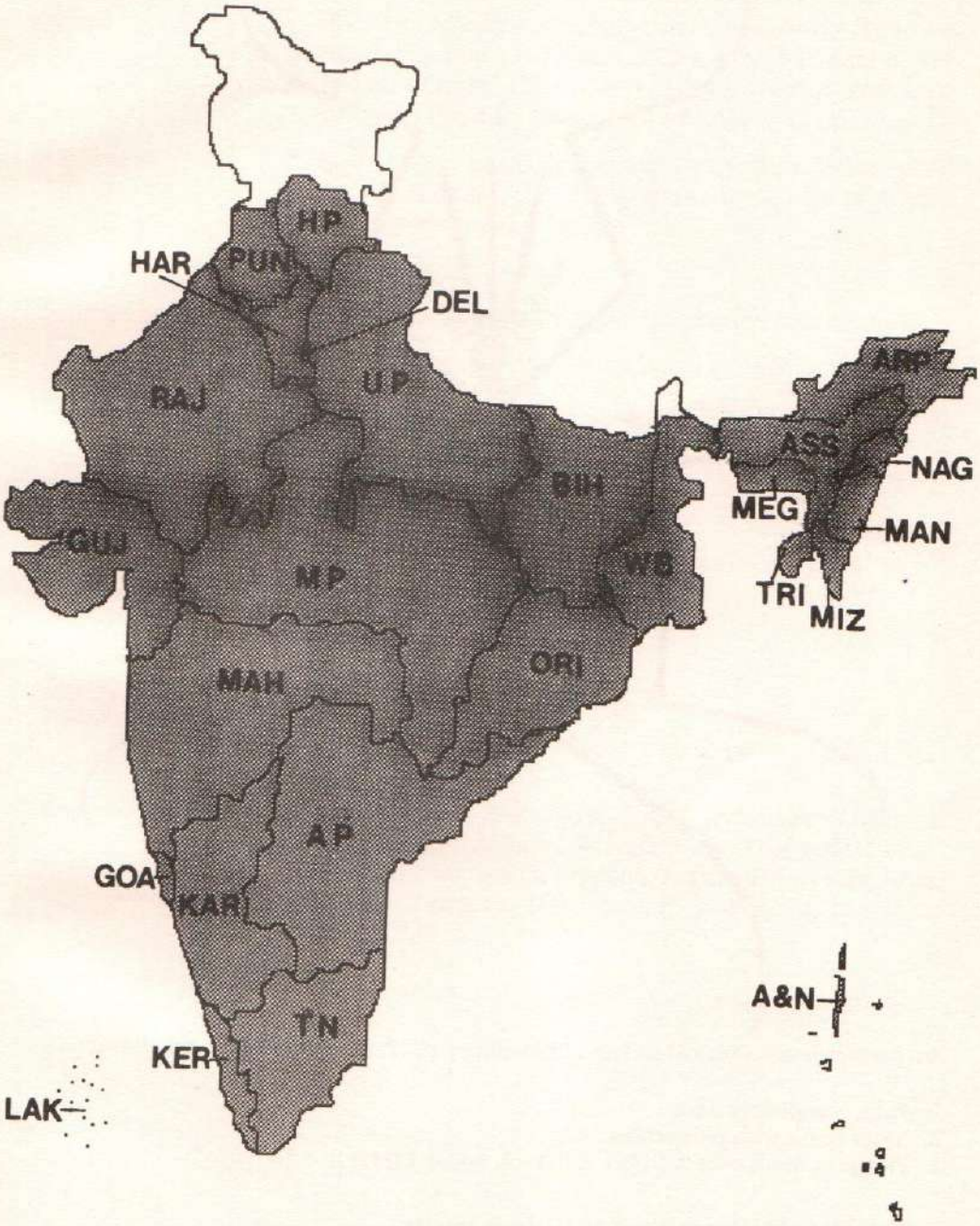
An. barbirostris Van der Wulp 1884, main identification characters

1. Palpi completely dark
2. Inner costa with pale scales
3. Hind leg tarsomeres with broad bands
4. Fringe spot on vein 3 (R4+5) and 5.2 (CU2)

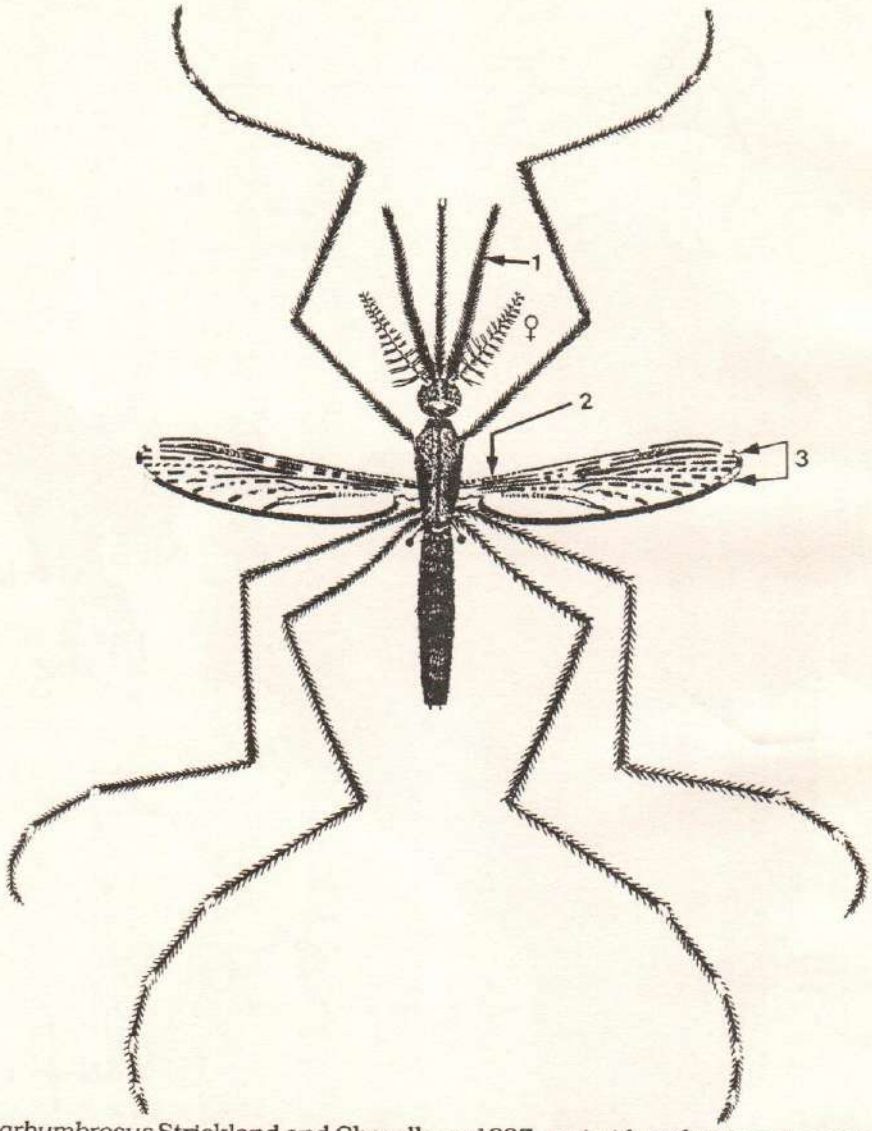
Anopheles barbirostris

Name	:	*An. barbirostris* Van der Wulp, 1884. *Notes from the Leyden Museum*, **6**: 248–256.
Derivative	:	Latin, *barba*, beard; *rostrum*, beak, bill, snout; *-is*, adjectival ending. Van der Wulp named the species *barbirostris*, because the proboscis is quite long and hairy and the rostrum and palpi are longer than the head and thorax taken together, both clothed with brown, scaly hairs; the joints of palpi are hardly distinguishable in this species.
Type form	:	Available at the State Museum of Natural History, Leyden, Netherlands.
Species complex	:	Eleven species (*An. barbirontris, An. campestris, An. donaldi, An. tranciscoi, An. hodgkini, An. pollicaris, An. ahomi, An. vanus, An. barbumbrosus, An. manalangi, and An. reidi*).
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Rests indoors in cattlesheds and human dwellings, also rests outdoors in jungles.
Breeding ecology	:	Breeds in ponds, small ground pools with vegetation or organic matter, borrowpits, ricefields, slow-running streams, shallow wells, tanks, and even salt sumps.
Biting time	:	Man and cattle before midnight. In jungles, bites during day-time also.
Feeding preference	:	Zoophilic but in the absence of animals bites man readily.
Flight range	:	Up to 1 km.
Susceptibility to insecticides	:	Resistant to DDT.
Relation to disease	:	A secondary vector of malaria and a recognized vector of human filaria in Indonesia. In India, found positive for filariasis (*B. malayi*) infection.
Reported distribution	:	Occurs in Bangladesh, North Borneo, China, India, Indonesia, Cambodia, Kalimantan, Laos, Malaysia, Moluccas, Myanmar, Nepal, Sri Lanka, Thailand, Timar and Vietnam. In India, recorded throughout the country.
Vector incrimination	:	NA

Reported distribution of *An. barbirostris* in the World.



Reported distribution of *An. barbirostris* in India.



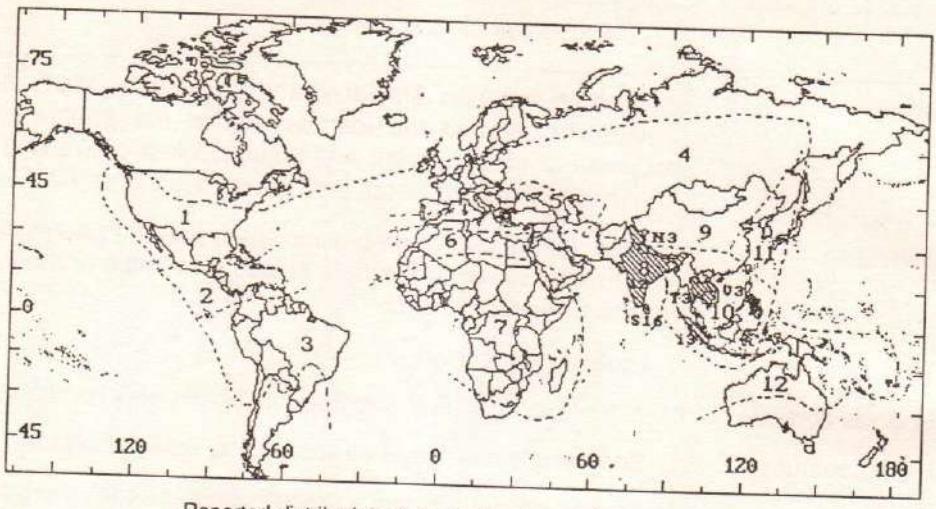
An. barbumbrosus Strickland and Chowdhury 1927, main identification characters

1. Palpi completely dark
2. Inner costa with pale scales
3. Fringe spot on vein 2.1 (R2), 3 (R4+5), and 4.1 (M1)

Further identification is based on larval characters

Anopheles barbumbrosus

Name	:	*An. barbumbrosus* Strickland and Chowdhury, 1927. *An Illustrated Key to the Identification of the Anopheline Larvae of India, Ceylon and Malaya*, West of Wallace's Line with Practical Notes on their collection, pp. 67.
Derivative	:	Latin, *barba*, beard; *umbrosus*, shady, dark. Presumably the name refers to the dark scales on female proboscis as seen in *barbirostris*.
Type form	:	Location not known.
Species complex	:	A member of *vanus*, subgroup of *barbirostris* complex.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Breeding ecology	:	Breeds on ground and in rocky pools, stream margins, ponds, puddles, swamps, margins, shallow wells, springs, ricefields, animal footprints, tree holes, water pots, etc.
Biting time	:	Before midnight.
Feeding preference	:	Man and wild animals.
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	NA
Reported distribution	:	Distributed in Cambodia, India, Indonesia, Malaysia, Nepal, South Vietnam, Sri Lanka, and Thailand. In India, reported from Andhra Pradesh, Assam, Bihar, Karnataka, Madhya Pradesh, Maharashtra, Tamil Nadu and West Bengal.
Vector incrimination	:	NA



Reported distribution of *An. barbumbrosus* in the World.

Reported distribution of *An. barbumbrosus* in India.

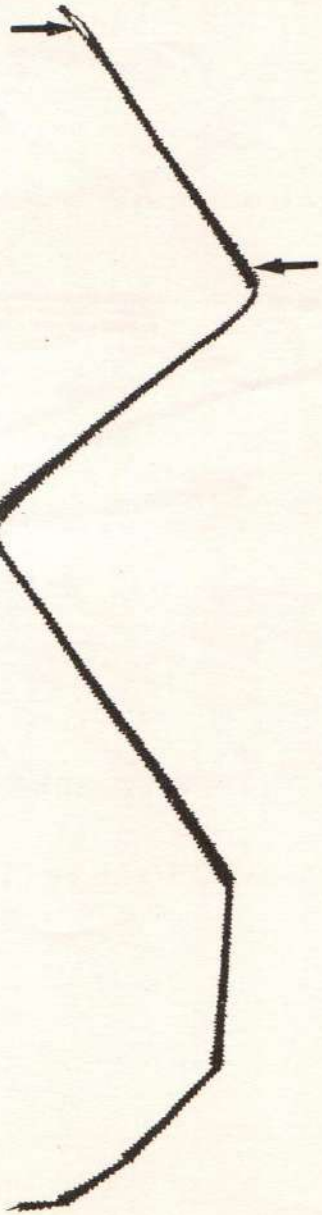
2.7 An. gigas, An. baileyi, An. gigas var. simlensis

Wing with 3 or less pale areas on the costa, subcosta including vein 1(R1)
Palpi dark but with small pale bands at the joints
Hind femur without tuft of dark and pale scales towards apex

Towards apex a large pale spot on dorsal side on mid-leg femur; pale spots on outer half of vein 6(Anal); a pale ring twice in diameter of femur on bases of femora

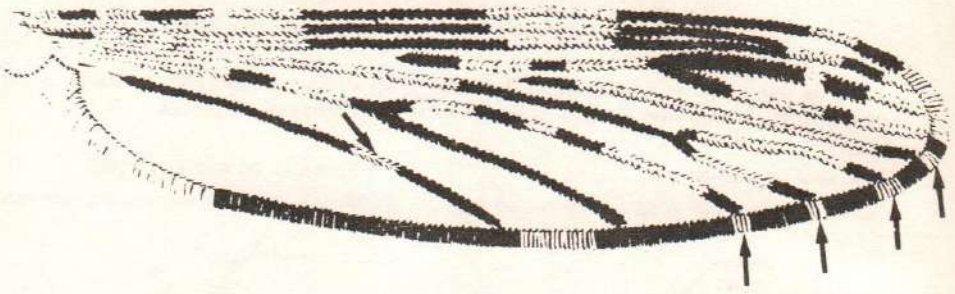
Pale spot on mid-leg
Bases of femora with a conspicuous pale ring

Pale spot on mid-leg absent
Bases of femora inconspicuously pale.



An. gigas, *An. baileyi*, *An. gigas* var. *simlensis*

Pale spot on outer half of vein 6(Anal)

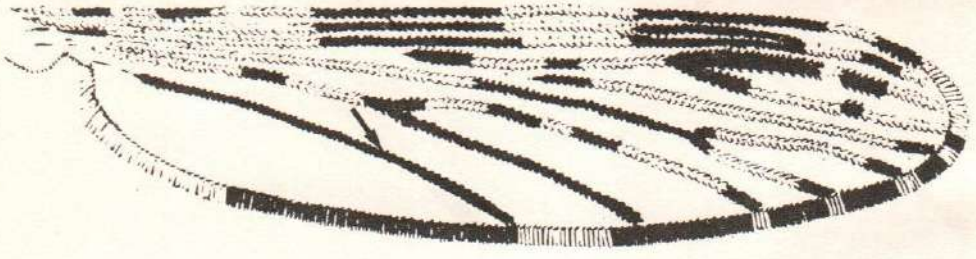


An. gigas

Pale spot on outer half of vein 6(Anal) absent

Other characters

Fringe spot on wing veins 3(R4+5), 4.1(M1), 4.2(M2), and 5.1(Cu1)



An. baileyi, *An. gigas* var. *simlensis*

An. baileyi, An. gigas var. *simlensis*

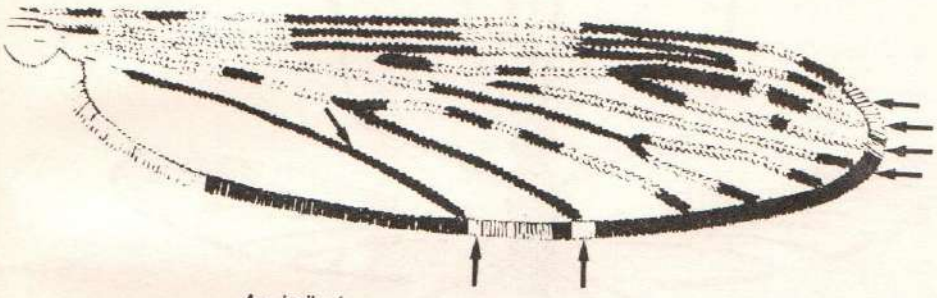
Fringe spot on vein 3(R4+5)

Absent

An. baileyi

Other characters

Fringe spot on wing veins 1(R1), 2.1(R2), 2.2(R3), 5.2(Cu2) and 6(Anal)



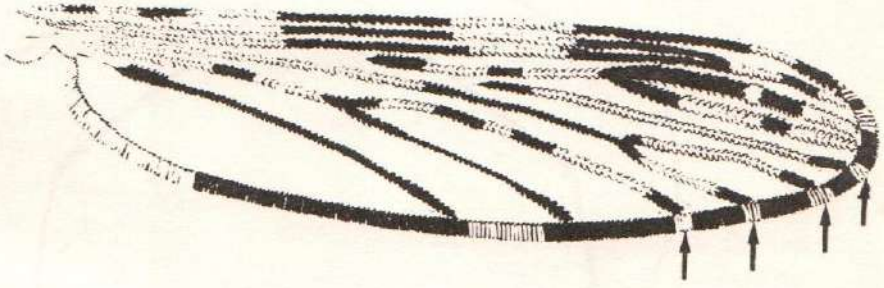
An. baileyi

Present

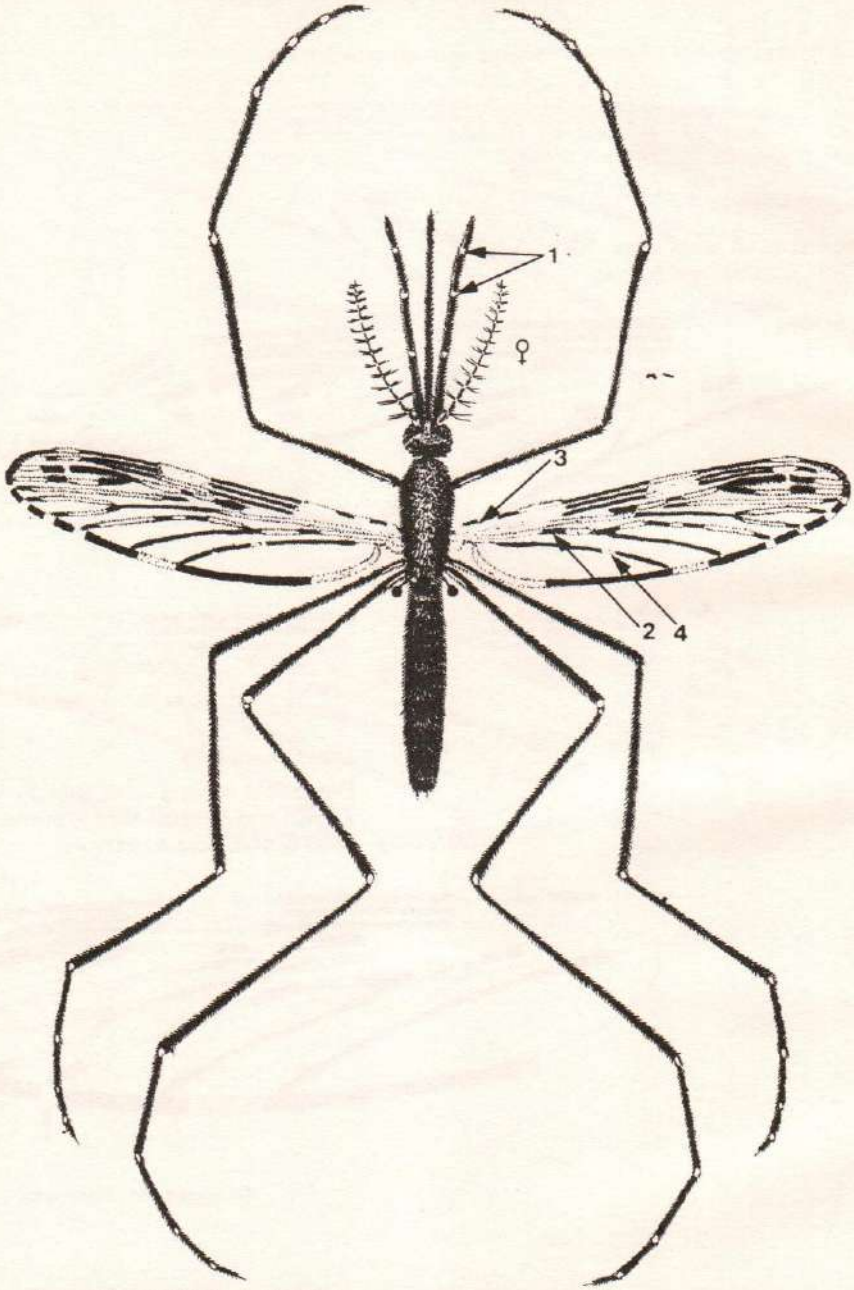
An. gigas var. *simlensis*

Other characters

Fringe spot on wing veins 3(R4+5), 4.1(M1), 4.2(M2) and 5.1(Cu1) but sometimes on only veins 3(R4+5) and 4.1(M1)



An. gigas var. *simlensis*



An. gigas Giles 1901, main identification characters

1. Palpi completely dark but small bands at joints
2. Basal dark area of vein 5 (CU) 1/6 of the stem
3. Inner costa interrupted
4. Vein 6 (Anal vein) with a pale spot on outer half

Anopheles gigas

Name	:	*An. gigas* Giles, 1901. *Entomologist's Monthly Magazine*, **37:** 196–198.
Derivative	:	Latin, *gigas*, giant, the sons of Earth and Tartarus (Greek, *gigas*). Giles found it to be the largest Indian form and named it accordingly.
Type form	:	Available at the British Museum of Natural History, London.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	Generally an outdoor rester, sometimes also rests in cattlesheds and human dwellings. The type form is apparently attracted by light. All the forms of *An. gigas* are normally recorded from high altitudes, i.e., more than 2000 m.
Breeding ecology	:	Breeding places are freshwater springs and ponds with vegetation on the edges, springs and seepages, ponds and small pools along shallow hill streams. The variety *simlensis* breeds in several habitats such as ground pools at the side of streams, ricefields, flooded wheat-fields, shallow swamps, seepage pools, snow-water pools, spring-bed pools, forest pools, rock holes, rainwater collections, and coaltar barrels with clean or turbid water.
Biting time	:	Before midnight.
Feeding preference	:	Wild animals and sometimes man.
Flight range	:	Reported up to 30.5 km.
Susceptibility to insecticides	:	NA
Relation to disease	:	NA
Reported distribution	:	The type form is distributed in Bangladesh, Borneo, India, Myanmar, Nepal, Sri Lanka, and Sumatra. The variety *simlensis* recorded from India, Nepal, Pakistan, Sri Lanka. In India, the type form and its variety *simlensis* are reported from Arunachal Pradesh, Assam, Delhi, Haryana, Himachal Pradesh, Karnataka, Kashmir, Manipur, Meghalaya, Mizoram, Nagaland, Punjab, Sikkim, Tamil Nadu, Uttar Pradesh, and West Bengal.
Vector incrimination	:	NA

Reported distribution of *An. gigas* in the World.

ARUNACHAL PRADESH (ARP)
1. Tirap
2. Subansiri

ASSAM (ASS)
1. Kamrup

HARYANA (HAR)
1. Karnal

HIMACHAL PRADESH (HP)
1. Kangara

JAMMU & KASHMIR (J & K)
1. Srinagar
2. Gulmarg

KARNATAKA
1. Mysore
2. Coorg

MANIPUR (MAN)
1. Imphal

MEGHALAYA (MEG)
1. Shillong

MIZORAM (MIZ)
1. Aizwal

NAGALAND (NAG)
1. Kohima

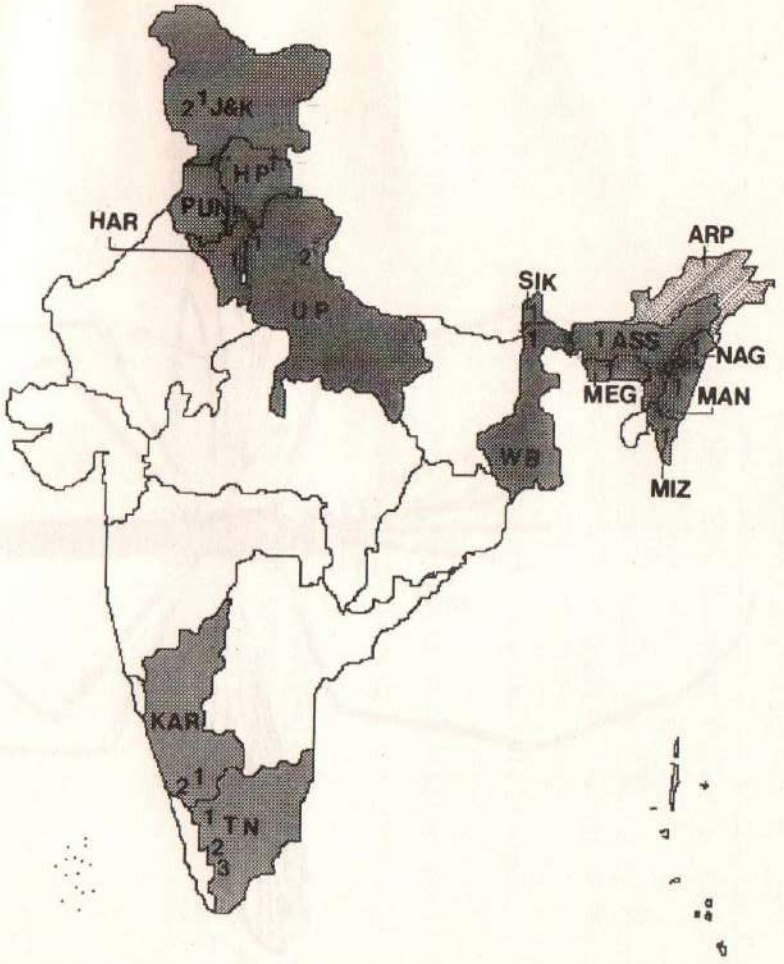
PUNJAB (PUN)
1. Patiala

SIKKIM (SIK)
1. Sikkim

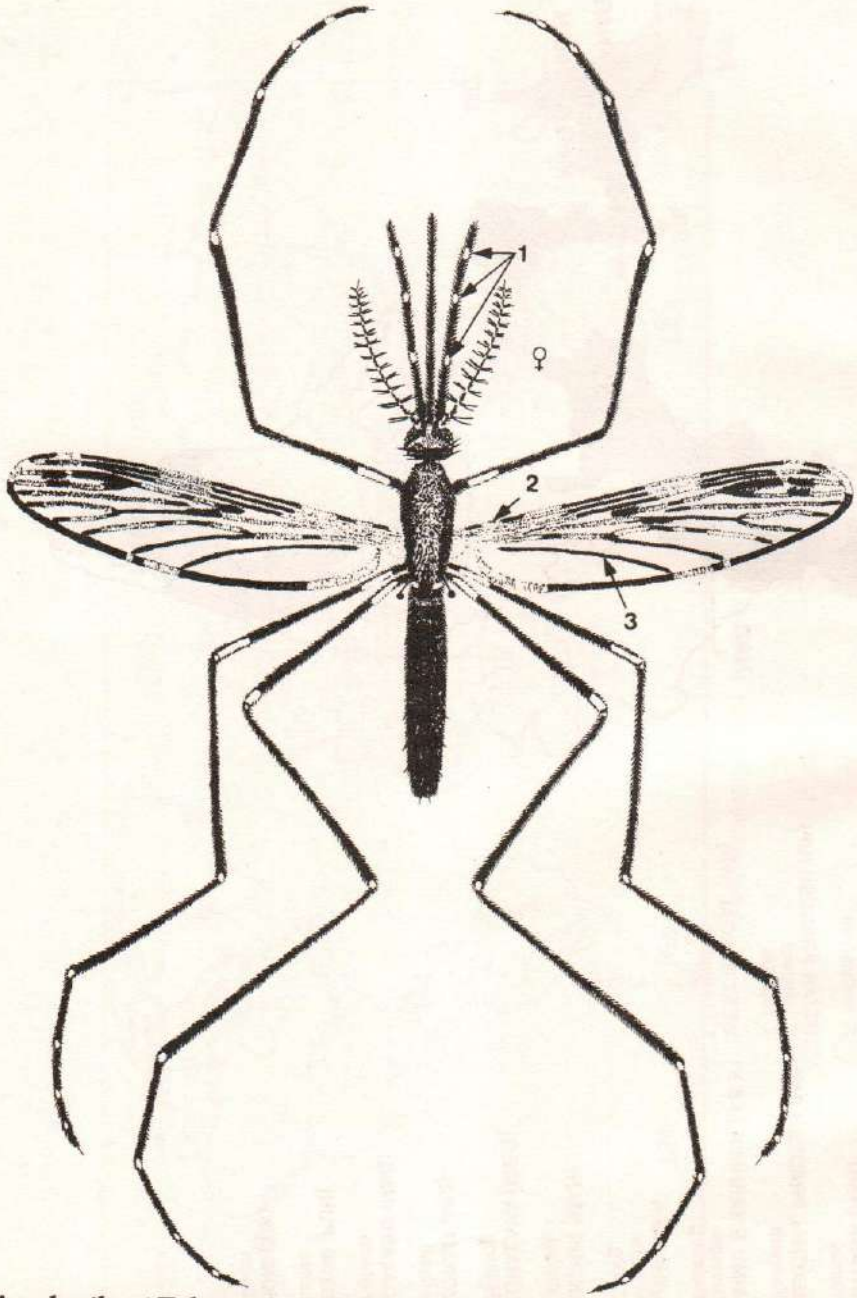
TAMIL NADU (TN)
1. Nilgiris
2. Western Ghat
3. Kodaikanal

UTTAR PRADESH (UP)
1. Hardwar
2. Nainital

WEST BENGAL (WB)
1. Darjeeling



Reported distribution of *An. gigas* in India.

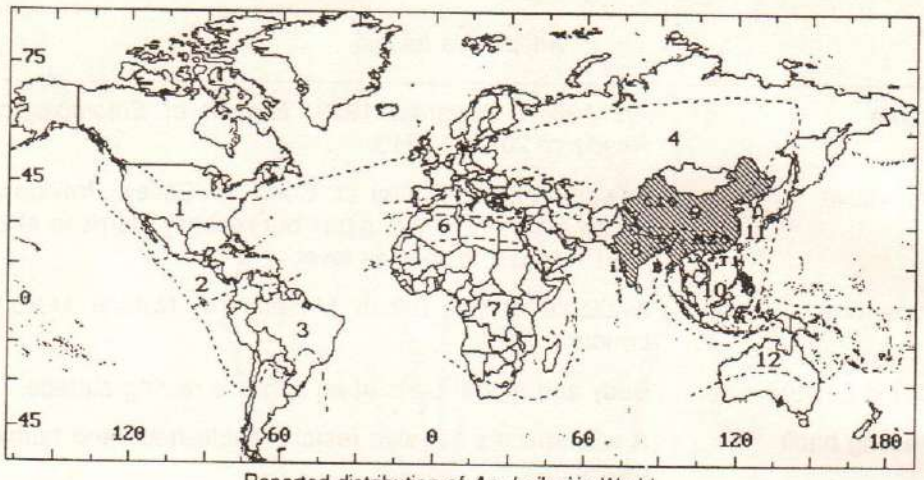


An. baileyi Edwards 1929, main identification characters

1. Palpi dark but with small bands at joints
2. Inner costa interrupted
3. Outer half of vein 6 (Anal vein) dark.

Anopheles baileyi

Name	:	*An. baileyi* Edwards, 1929. *Bulletin of Entomological Research* **20:** 321–343.
Derivative	:	Edwards named it after Lt. Col. F.M. Bailey. Previously it was a variety of *An. gigas* but recently Harrison et al. 1991 raised it to species level.
Type form	:	Available at the British Museum of Natural History, London.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	A wild species but also rests in cattlesheds and human dwellings.
Breeding ecology	:	Species breeds throughout the year in deep pools, rocky pools and perennial springs.
Biting time	:	NA
Feeding preference	:	Wild animals.
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	NA
Reported distribution	:	Occurs in Bangladesh, Central China, Indochina, India, Myanmar, Taiwan and Tibet. In India recorded from Assam and Meghalaya.
Vector incrimination	:	NA



Reported distribution of *An. baileyi* in World.

ASSAM (ASS)
1. Kamrup

MEGHALAYA (MEG)
1. Shillong

Reported distribution of *An. baileyi* in India.

2.8. An. annandalei, An. interruptus

Wing with 3 or less pale areas on the costa, subcosta including vein 1(R1)
Palpi dark but with small pale bands at the joints
Hind femur with a tuft of dark and pale scales towards apex

Subcostal pale spot on costa

Absent

An. annandalei

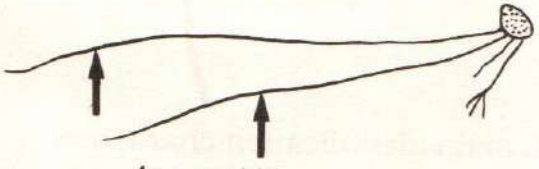
Present

An. interruptus

The species can be confirmed by the larval characters

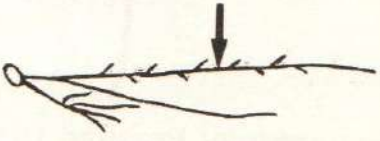
Branches of the thoracic pleural hairs

Without any branch (simple)

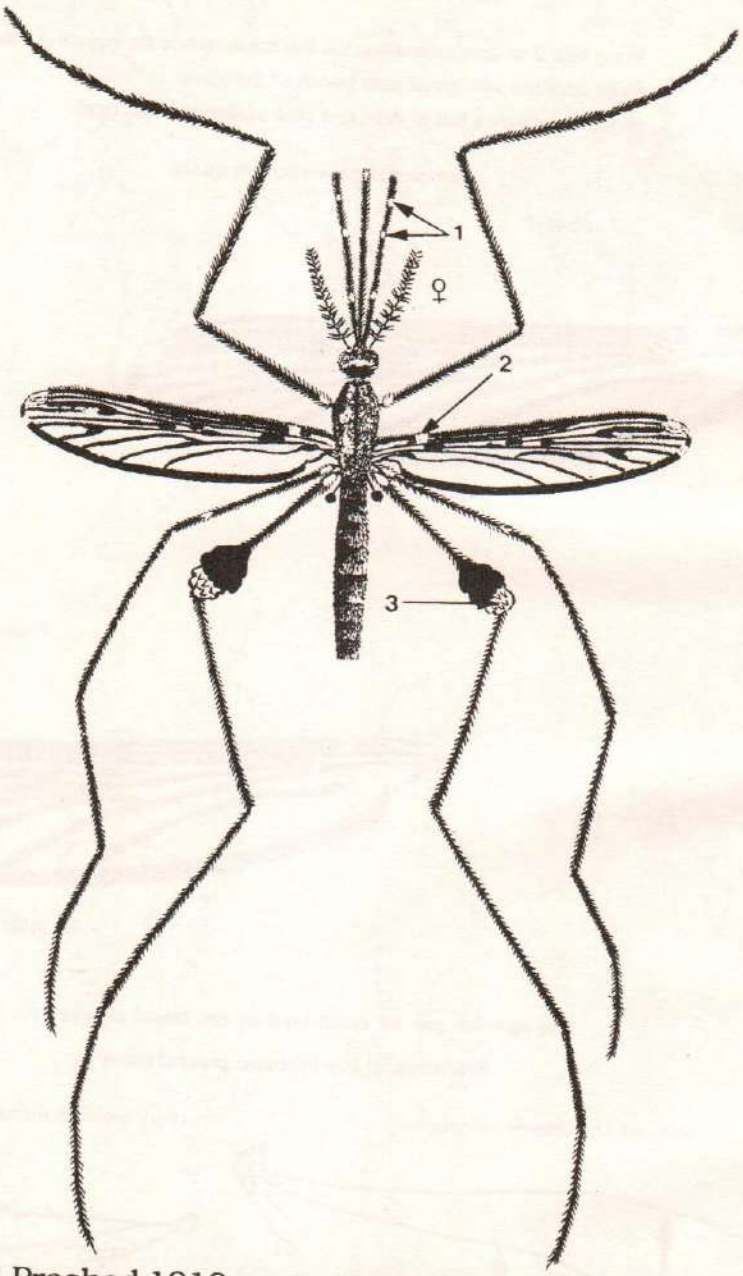


An. annandalei

Very small branches (barb-like)



An. interruptus



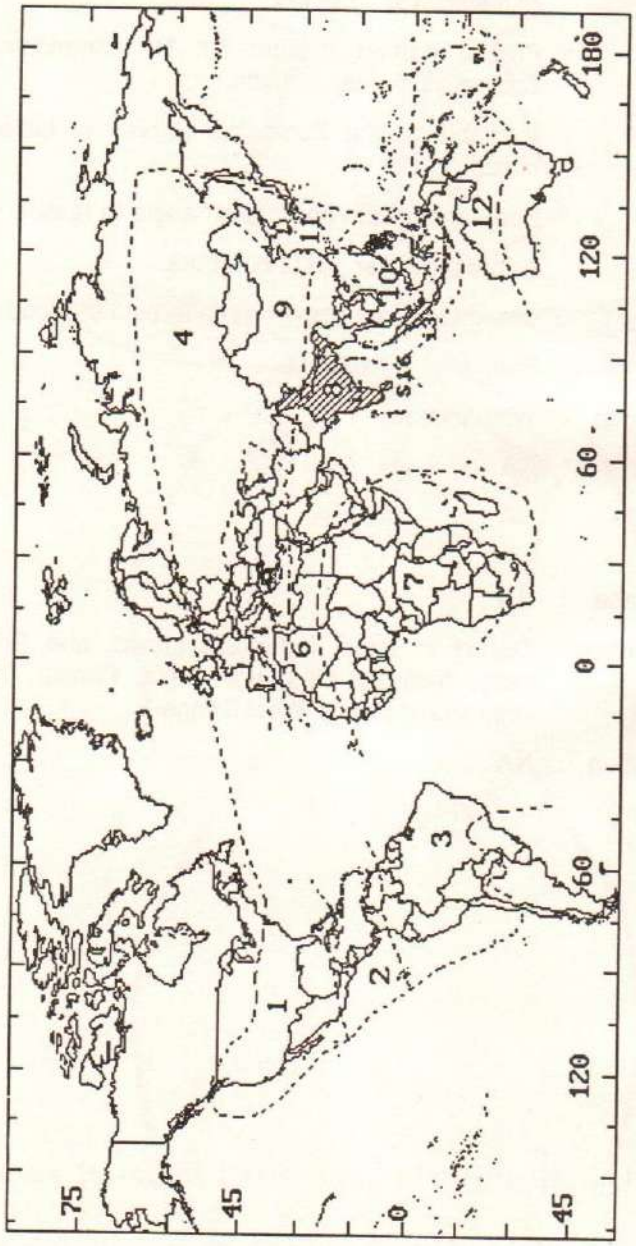
An. annandalei Prashad 1918, main identification characters

1. Palpi completely dark but small bands at joints
2. Inner costa interrupted
3. Apex of the hind femur with prominant tuft of white and black scales

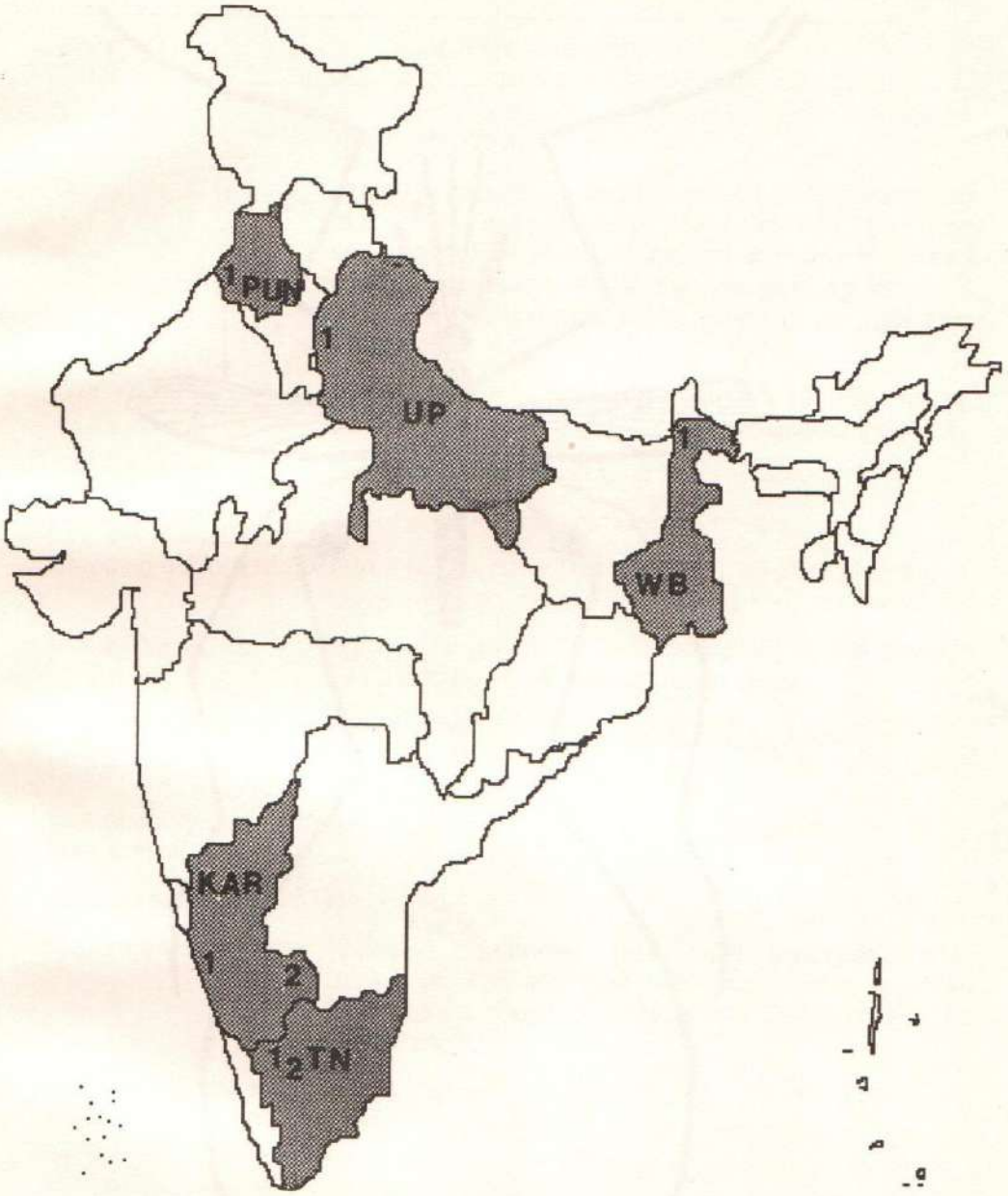
Further identification is based on larval characters

Anopheles annandalei

Name	:	*An. annandalei* Prasad 1918. *Records of the Indian Museum*, **15:** 123–127.
Derivative	:	Prasad named it after Dr. N. Annandale, Director, Zoological Survey of India.
Type form	:	Available at the Zoological Survey of India, Calcutta, India.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	A forest dweller, rests outdoors.
Breeding ecology	:	Breeds in tree holes in deep forests or wooded country.
Biting time	:	Bites before midnight.
Feeding preference	:	Wild animals.
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	NA
Reported distribution	:	Occurs in India, Indonesia (Java), and Sri Lanka. In India, recorded from Karnataka, Punjab, Tamil Nadu, Uttar Pradesh and West Bengal.
Vector incrimination	:	NA



Reported distribution of *An. annandalei* in the World.



KARNATAKA (KAR)
1. Shimoga
2. Hassan

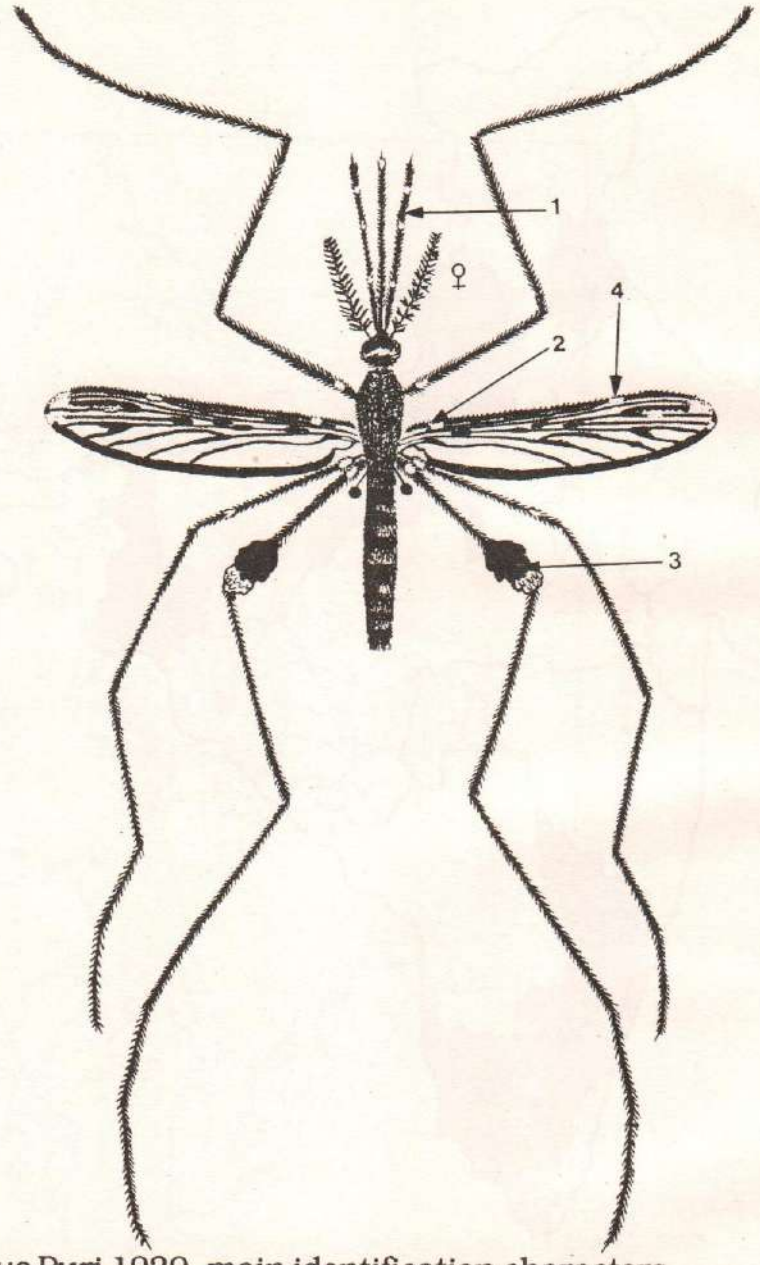
PUNJAB (PUN)
1. Ferozepur

TAMIL NADU (TN)
1. Nilgiris
2. Western Ghats

UTTAR PRADESH (UP)
1. Dehra Dun

WEST BENGAL (WB)
1. Darjeeling

Reported distribution of *An. annandalei* in India.



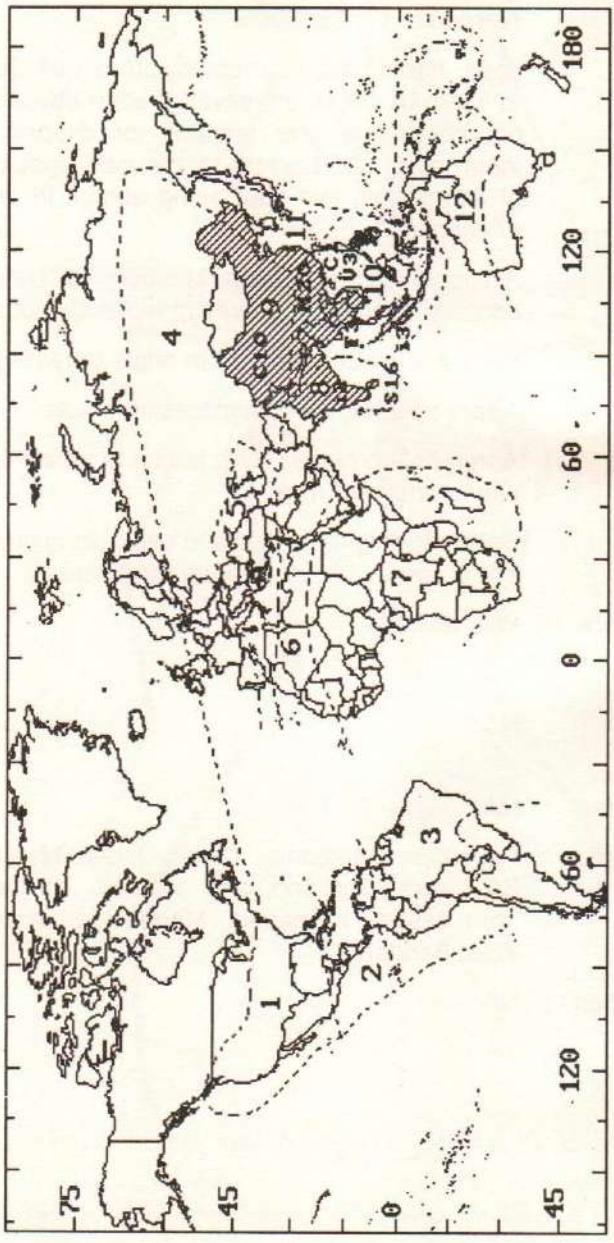
An. interruptus Puri 1929, main identification characters

1. Palpi completely dark but small bands at joints
2. Inner costa interrupted
3. Apex of the hind femur with prominant tuft of white and dark scales
4. Sub costal pale spot on costa

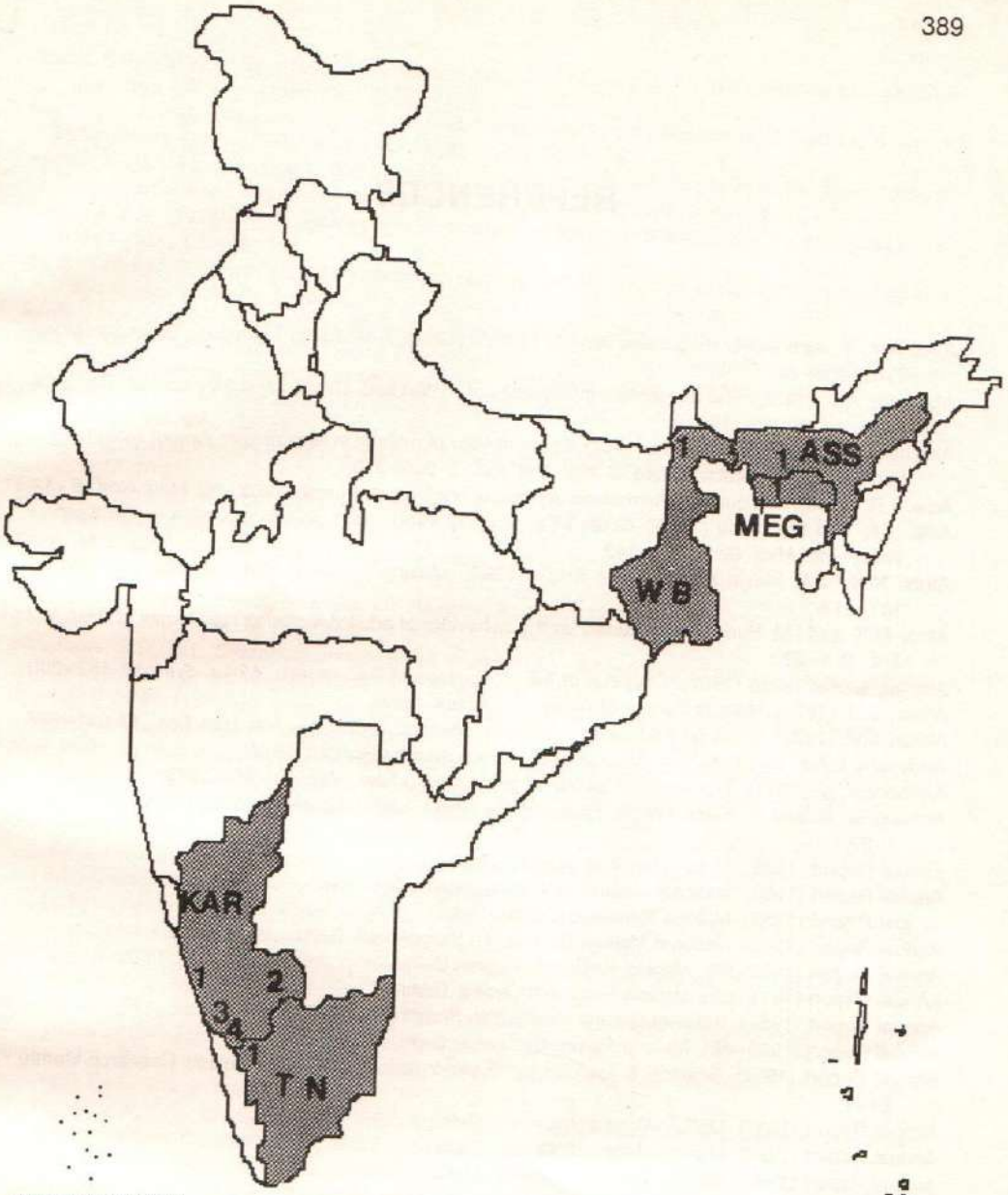
Further identification is based on larval characters

Anopheles interruptus

Name	:	*An. interruptus* Puri, 1929. *The Indian Journal of Medical Research*, **17:** 385–395.
Derivative	:	Latin, *interruptus*, interrupted, broken off; (*interrumpere*, to interrupt, break off, sever, break between). Puri does not specifically give reasons for choosing the name *interruptus*, but it refers to the pale spot on the costa of *interruptus*, this spot being absent in the type form *annandalei*.
Type form	:	Available at the British Museum of Natural History, London; Zoological Survey of India, Calcutta, India.
Sitting posture	:	Body and mouth parts at an angle to resting surface.
Resting habit	:	A rare species, rests outdoors in forests.
Breeding ecology	:	A tree-hole breeder, collected up to an altitude of 900 m. Larvae are very dark.
Biting time	:	Before midnight. In Thailand peak biting time is between 19.00 and 20.00 hrs in deep forest areas.
Feeding preference	:	Wild animals.
Flight range	:	NA
Susceptibility to insecticides	:	NA
Relation to disease	:	NA
Reported distribution	:	Found in Cambodia, China, India, Myanmar, Nepal, Sri Lanka, Thailand, and Vietnam. In India recorded from Assam, Karnataka, Meghalaya, Tamil Nadu, and West Bengal.
Vector incrimination	:	NA



Reported distribution of *A. interruptus* in the World.



ASSAM (ASS)
1. Kamrup

KARNATAKA (KAR)
1. Hassan
2. Shimoga
3. Mysore
4. Coorg

MEGHALAYA (MEG)
1. Shiliong

TAMIL NADU (TN)
1. Nilgiris

WEST BENGAL (WB)
1. Darjeeling

Reported distribution of *A. interruptus* in India.

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GLOSSARY

Acellular. The term applied to unicellular organisms which are complex in structure and function.

Adaptation. The condition of showing fitness for a particular environment, as applied to characteristics of a structure, function, or entire organism; also the process by which such fitness is acquired.

Affinity. Relationship. Sometimes misleadingly used as synonym for phenetic similarity.

Allochronic species. Species which do not occur at the same time level.

Allopatric. Of populations or species, occupying mutually exclusive (but usually adjacent) geographical areas.

Allopatric speciation. Species formation during geographical isolation.

Allotype. A paratype of the opposite sex to the holotype.

Analogous. The similar function but not of similar origin.

Alpha taxonomy. The level of taxonomy concerned with the characterization and naming of species.

Anatomy. The science of internal morphology, as revealed by dissection.

Anopheles. Genus (or subgenus) of mosquito of the subfamily Anophelinae.

Anopheline. Subfamily of the Culicidae which includes the genus *Anopheles*.

Anophelism. Presence of anophelines in a locality, irrespective of the presence of malaria.

Anthropophilic. Showing a preference for feeding on man even when non-human hosts are available. A relative term requiring qualification so as to indicate the extent of this preference.

Artificial classification. Classification based on convenient and conspicuous diagnostic characters without attention to characters indicating relationship; often a classification based on single, arbitrarily chosen character instead of an evaluation of the totality of characters.

Atlas. In taxonomy, a method of presenting taxonomic materials primarily by means of comparative illustrations rather than by comparative descriptions (e.g. monograph).

Beta taxonomy. The level of taxonomy concerned with the arranging of species into a natural system of lower and higher taxa (e.g. Alpha taxonomy, Gamma taxonomy).

BHC (See also HCH). Abbreviation and common name of benzene hexachloride, a chlorinated hydrocarbon insecticide comprising essentially a mixture of isomers of 1,2,3,4,5,6-hexachlorocyclohexane in the form of whitish to light-brown granules, flakes, or powder. The gamma-isomer is the most active constituent. The grades of BHC commercially available are distinguished according to their gamma-isomer content as follows: technical BHC: 12%-16%, refined BHC: 16.1-98.9%, lindane: 99%-100%.

Bilateral symmetry. Symmetry about a single plane, so that there is one way only in which the body can be divided into two similar halves.

Binary. Refers to designations consisting of two kinds of names.

Binomial nomenclature. The system of nomenclature first standardized by Linnaeus and now generally referred to as binominal nomenclature.

Biological classification. The arranging of organisms into taxa on the basis of inferences concerning their genetic relationship.

Biological races. Non-interbreeding sympatric populations, which differ in biology but not, or scarcely, in morphology; supposedly prevented from interbreeding by preference for different food plants or other hosts.

Biological species concept. A concept of the species category stressing reproductive isolation, and the possession of a genetic programme effecting such isolation.

Biota. The flora and fauna of a region.

Biting-capture. Collection of mosquitoes caught in the act of feeding on a human or an animal host.

Biting cycle. Regular variations in the amount of blood-feeding activity exhibited by populations of mosquito species during each 24-hour day and night period.

Cladism. A taxonomic theory by which organisms are ordered and ranked entirely on the basis of "recency of common descent," that is, on the basis of the most recent branching point of the inferred phylogeny.

Classification. The delimitation, ordering, and ranking of taxa.

Clone. All the offspring derived by asexual reproduction from a single sexually produced individual.

Clustering methods. Methods of grouping related or similar species into species groups or higher taxa.

Complex. A neutral term for a number of related taxonomic units, most commonly involving units in which the taxonomy is difficult or confusing.

Compound eye. Eye composed of numerous separate image-forming elements. Found only in insects and crustaceans.

Congeneric. A term applied to species of the same genus.

Conspecific. A term applied to individuals or populations of the same species.

Continuity. In nomenclature, the principle that continuity of usage should take precedence over priority of publication in determining which of two or more competing scientific names should be adopted for a particular taxon.

Continuous variation. Variation in which individuals differ from each other by infinite steps, as variation in quality of expression of a character or group of characters.

Convergence. Morphological similarity in but distantly related forms.

Cotype. Syntype (q.v.).

Cryptic species. Sibling species (q.v.).

DDT. Abbreviation and common name of dichlorodiphenyl-trichloroethane, a chlorinated hydrocarbon insecticide comprising essentially 1,1,1-trichloro-2,2-di-(*p*-chlorophenyl)ethane in the form of white or cream-coloured granules, flakes or powder. Technical DDT should contain a minimum of 70% by weight of *p,p'*-isomer having a minimum melting point of 104°C.

Density, anopheline. Number of female anophelines in relation to the number of specified shelters or hosts (e.g. per room, per trap, or per person) or to a given time period (e.g. overnight or per hour), specifying method of collection.

Dieldrin. Chlorinated hydrocarbon insecticide, comprising essentially 1,2,3,4,10,10-hexachloro-6, 7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-endo-1,4-exo-5,8-dimethanonaphthalene (HEOD). Technical dieldrin should contain at least 76.5% by weight of HEOD.

Diploblastic. Having the body organised from only two embryonic cell layers (ectoderm and endoderm).

Direct development. Development without a larval form.

Discontinuous variation. Variation in which the individuals of a sample fall into definite classes which do not grade into each other.

Distal. Situated away from the point of origin or attachment.

Distribution. Geographical, seasonal, ecological or topographical range of an organism.

Ecological isolation. A condition in which interbreeding between two or more otherwise sympatric populations is believed to be prevented by mating in different ecologic niches.

Ecological race. A local race that owes its most conspicuous attributes to the selective effect of a specific environment.

Ecology. The study of the interactions between organisms and their environment.

Ecospecies. "A group of population so related that they are able to exchange genes freely without loss of fertility or vigour in the offspring" (Turesson).

Ecotype. A descriptive term applied to plant races of varying degrees of distinctness which owe their most conspicuous characters to the selective effects of local environments.

Emendation. In nomenclature, an intentional modification of the spelling of a previously published scientific name.

Endophagy. Tendency of mosquitoes to feed indoors.

Endophily. Tendency of mosquitoes to rest indoors, whether by day or by night.

Endopterygote insect. Insect with complete metamorphosis, i.e. the juvenile form is a wingless larva unlike adult in both appearance and mode of life. The abrupt change into the adult form takes place during a pupal stage.

Eucaryotes. Organisms with a well-defined nucleus and meiosis. All higher organisms above the level of procaryotes (q.v.).

Excito-repellency. Property in an insecticide of stimulating irritability in insects.

Exophagy. Tendency of mosquitoes to feed outdoors.

Exophily. Tendency of mosquitoes to rest outdoors, whether by day or by night.

Exopterygote insect. Insect with incomplete metamorphosis, i.e. the juvenile form is a nymph whose wings develop gradually by small increments at each moult.

Evolution. The process of very slow and gradual change which occurs in the descendent generations of populations of organisms by a process of natural selection.

Family. A taxonomic category including one genus or a group of genera or tribes of common phylogenetic origin, which is separated from related similar units (families) by a decided gap, the size of the gap being in inverse ratio to the size of the family.

Family name. The scientific designation of a taxon of family rank, recognized by the termination *idae*, which termination may not be used in names of other taxa.

Fauna. The animal life of a region.

Faunal work. A publication in which taxa are included on the basis of their occurrence in a specified area rather than on the basis of relationship.

Flight, migratory. Directional flight of a group of mosquitoes, not subject to the ordinary laws of dispersion.

Flight, pre-hibernation. Dispersion or migration of mosquitoes occurring before and in relation to hibernation, often to greater-than-normal distances.

Flight range, effective. Distance from a breeding place that the females of a given species of mosquito travel in numbers sufficient to maintain endemic malaria or to cause an epidemic.

Flora. The plant life of a region.

Gamma taxonomy. The level of taxonomy dealing with various biological aspects of taxa, ranging from the study of intraspecific populations to studies of speciation and of evolutionary rates and trends.

Genotype. The genetic constitution of an individual or taxon (cf. Phenotype). Use of this term in nomenclature for the type-species of a genus is confusing and contrary to the terminology of the Code.

Genus. A category for a taxon including one species or a group of species, presumably of common phylogenetic origin, which is separated from a related, similar unit (genera) by a decided gap, the size of the gap being in inverse ratio to the size of the unit (genus).

Geographic isolate. A population that is separated by geographic barriers from the main body of the species.

Geographical race. Subspecies (q.v.).

Geographical reconnaissance. In malaria eradication terminology, the operation which provides the basis for the choice of field centres and depots, for detailed schedules and itineraries of spraying and surveillance personnel, for the final deployment of transport, and for numerical control of the completeness of work accomplished. It includes collection of information on the number, type, location and means of access of all houses and field shelters, as well as on communications, health units, vehicle-repair facilities, population movements and other relevant factors.

Gynandromorph. An individual in which one part of the body is masculine, the other feminine; most frequent are bilateral gynandromorphs, in which the left and right halves are of different sex.

HCH. HCH (Hexachlorocyclohexane), also known as BHC belongs to Organochlorine. Technical-grade HCH consists of 65-70% alpha-HCH, 7-10% beta-HCH, 14-15% gamma-HCH, and approximately 10% of other isomers and compounds. Lindane contains > 99% gamma-HCH. It is a solid, with a low vapour pressure, and is poorly soluble in water but very soluble in organic solvents, such as acetone, and in aromatic and chlorinated solvents. The n-octanol/water partition coefficient (log P) is 3.2-3.7.

Holistic. Looking at wholes as more than the sums of their parts.

Holotype. The single specimen designated or indicated as "the type" by the original author at the time of the publication of the original description.

Homologous. A feature in two or more taxa which can be traced back to the same feature in the common ancestor of these taxa.

Homonym. In nomenclature, one of two or more identical but independently proposed names for the same or different taxa.

Host races. Different genetic races of the same species in oligophagous food specialists or parasites occurring on different hosts.

Hypodigm. The entire material of a species that is available to a taxonomist.

Identification. The determination of the taxonomic identity of an individual.

Infraspecific. Within the species; usually applied to categories (subspecies) and phena (varieties).

Infrasubspecific form. Individual and seasonal variants in a single interbreeding population.

Infrasubspecific name. A name given to an infrasubspecific form.

Insecticide. Product that kills insects either in their immature stages ("ovicide, larvicide") or in their adult stage ("immediate imagicide" or "residual imagicide").

Instar. Stage between successive ecdyses during the larval development of an insect.

International Code of Zoological Nomenclature. The official set of regulations dealing with zoological nomenclature.

Intersex. An individual more or less intermediate in phenotype between male and female.

Junior homonym. The more recently published of two or more identical names for the same or different taxa.

Junior synonym. The more recently published of two or more available synonyms for the same taxon.

Key, taxonomic. List of distinguishing morphological characters so arranged as to facilitate identification of species. The commonest form is the dichotomous key, in which the characters are displayed as pairs of alternatives ("couplets").

Lectotype. One of a series of syntypes which, subsequent to the publication of the original description, is selected and designated through publication to serve as "the type".

Lumper. A taxonomist who emphasizes the demonstration of relationship in the delimitation of taxa and who tends to recognize large taxa.

Macrotaxonomy. The classification of higher taxa.

Malathion. An organophosphorus insecticide. Technical malathion should contain O,O-dimethyl S-[1,2-di-(ethoxycarbonyl) ethyl] phosphorodithioate in proportion by weight of not less than 95%.

Metamorphosis. The series of changes which take place as a larva transforms into the adult form.

Monograph. In taxonomy, an exhaustive treatment of a higher taxon in terms of all available information pertinent to taxonomic interpretation; usually involving full systematic treatment of the comparative anatomy, biology, ecology, and detailed distributional analyses of all included taxa.

Monotypic. The taxon containing only one immediately subordinate taxon, as a genus containing one species, or a species containing but one (the nominate) subspecies.

Morphospecies. A typological species recognized merely on the basis of morphological differences.

Multivariate analysis. The simultaneous analysis of several variable characters.

Natural selection. The unequal contribution of genotypes to the gene pool of the next generation, through differential mortality and differences in reproductive success, caused by components of the environment.

Neoteny. Attainment of sexual maturity in an immature or larval stage.

Neotype. A specimen selected as type subsequent to the original description in cases where the original types are known to be destroyed or were suppressed by the Commission.

New name. A replacement name for a preoccupied name.

Niche (ecological). The precise constellation of environmental factors into which a species fits or which is required by a species.

Nomenclator. A book containing a list of scientific names assembled for nomenclatural, rather than taxonomic purposes.

Nomenclature. A system of names.

Nomen dubium. The name of a nominal species for which available evidence is insufficient to permit recognition of the zoological species to which it was applied.

Nomen oblitum. A name losing its validity under the statute of limitation.
Nominal taxon (species, genus etc.). A named taxon, objectively defined by its type.
Non-dimensional species. The species concept represented by the non-interbreeding of species at a given place and time.
Nymph. Juvenile stage of exopterygote insect, resembling adult in many ways, but lacking wings.
Oligogenic character. A character determined by only a few genes.
Ontogeny. The developmental history of an individual organism from egg to adult.
Original description. A statement of characters accompanying the proposal of a name for a new taxon in conformity with Arts.
Parasite. Organism living in or on another living organism (host) from which it derives its food.
Paratype. A specimen other than the holotype which was before the author at the time of preparation of the original description and was so designated or indicated by the original author.
Patronymic. In nomenclature, dedicatory name, a name based on that of a person or persons.
Phylogency. The study of the history of the lines of evolution in a group of organisms; the origin and evolution of higher taxa.
Polytypic. A taxon containing two or more taxa in the immediately subordinate category, as a genus with several species or a species with several subspecies.
Pre-Linnaean name. A name published prior to 1 January, 1758, the starting point of zoological nomenclature.
Primary homonym. Each of two or more identical species-group names which, at the time of original publication, were proposed in combination with the generic name (e.g. *X-us albus* Smith, 1910, and *X-us albus* Jones, 1920).
Primary zoological literature. Literature dealing with animals or zoological phenomena, not merely a listing of names.
Priority. The principle that of two competing names for the same taxon (below the rank of an infraorder) ordinarily that is valid which was published first.
Proboscis. Insect mouth parts specialised for sucking up fluid. Trunk of elephant.
Procaryotes. Microorganisms (virus, bacteria, blue-green algae) that lack well defined nuclei and meiosis.
Pupa. Stage between the larva and the imago in the development of the mosquito, during which it is aquatic and active but does not feed. When the larva undergoes metamorphosis into a pupa ("pupation") the fourth and last larval skin is cast.
Race. Genetically distinct mating group within a species. To be distinguished from a subspecies, which is geographically isolated as well as being genetically distinct.
Race. Subspecies (q.v).
Rate, anopheline infection. Percentage of female anophelines of a given species found, by dissection within 24 hours of capture, to contain malaria parasites either as sporozoites in the salivary glands or as oocysts on the midgut wall.
Rate, biting. Average number of mosquito bites received by a host in unit time, specified according to host and mosquito species.
Rate, oocyst. Percentage of female *Anopheles* caught in nature and found, on dissection within 24 hours of capture, to contain oocysts in the midgut.
Rate, sporozoite. Percentage of female *Anopheles* caught in nature and found, on dissection within 24 hours of capture, to contain sporozoites in the salivary glands.
Resistance. 1. Ability of a parasite strain to multiply or to survive in the presence of concentrations of a drug that normally destroy parasites of the same species or prevent their multiplication. Such resistance may be relative (yielding to increased doses of the drug tolerated by the host). 2. Ability in a population of insects to tolerate doses of an insecticide which would prove lethal to the majority of individuals in a normal population of the same species; developed as a result of selection pressure by the insecticide. Simultaneous resistance to one or more insecticides of two different groups is known as double insecticide resistance (not to be confused with insecticide cross-resistance).
Scientific name. The binominal or trinominal designation of an animal; the formal nomenclatural designation of a taxon.

Secondary homonym. Each of two or more identical specific names which, at the time of original publication were proposed in combination with different generic names but which through subsequent transference, reclassification or combination of genera have come to bear the same (or an identical) combination of a generic and specific name.

Semispecies. The component species of superspecies (Mayr); also, populations that have acquired some, but not yet all, attributes of species rank; borderline cases between species and subspecies.

Senior homonym. The earliest published of two or more identical names for the same or different taxa.

Senior synonym. The earliest published of two or more available synonyms for the same taxon.

Sibling species. Pairs or groups of closely related species which are reproductively isolated but morphologically identical or nearly so.

Species. Group of organisms capable of exchanging genetic material with one another and incapable, by reason of their genetic constitution, of exchanging such material with any other group of organisms. The limits of species are indicated by the comparative study of morphological and other characters.

Species complex. Group of closely related organisms, the exact specific status of which is uncertain although they resemble some well-recognized type species.

Species eradication. Complete elimination from a territory of one or more species of malaria vectors.

Species-group. An assemblage of coordinate categories, viz. species and subspecies.

Species. Groups of actually (or potentially) interbreeding natural populations which are reproductively isolated from other such groups.

Subfamily. A category of the family-group subordinate to the family; and individual taxon ranked in the category subfamily.

Subgeneric name. The name of an optional category between the genus and the species enclosed in parentheses when cited in connection with a binominal or trinominal combination and therefore excluded from consideration when determining the number of words of which a specific or subspecific name is composed (e.g., *X-us (Y-us) albus rufus* is a trinominal).

Subjective synonym. Each of two or more synonyms based on different types, but regarded as referring to the same taxon by those zoologists who hold them to be synonyms.

Subspecies. A geographically defined aggregate of local populations which differs taxonomically from other such subdivision of the species.

Substitute name. A name proposed to replace a preoccupied name and automatically taking the same type and type-locality (= New name).

Superfamily. The taxonomic category immediately above the family and below the order; an individual taxon ranked in this category.

Superspecies. A monophyletic group of entirely or largely allopatric species.

Supraspecific. A term applied to a category or evolutionary phenomenon above the species level.

Susceptibility. 1. Liability in a population of insects to be killed by a particular insecticide. The average susceptibility of a species or population of mosquitoes is usually measured in terms of the median lethal concentration (LC50). 2. Liability of a species of mosquito to become infected when fed on a person known to be infectious; usually measured in relation to the liability of infection of another species fed at the same time on the same person. 3. Liability of a person to become infected. The lower the immunity, the higher the susceptibility.

Swarming. Nuptial flight or dance in which males of some species of mosquito gather together on the wing, usually at dusk or in dim light, in the open, moving up and down without horizontal progression; the females fly into the swarm of males, and copulation takes place in the air.

Sympatric speciation. Speciation without geographic isolation; the acquisition of isolation mechanisms within a deme.

Sympatry. The occurrence of two or more populations in the same area; more precisely; the existence of a population in breeding condition within the cruising range of individuals of another population.

Synchronic species. Species which occur at the same time level.

Synonym. In nomenclature, each of two or more different names for the same taxon.

Synonymy. A chronological list of the scientific names which have been applied to a given taxon, including the dates of publication and the authors of the names.

Synopsis. In taxonomy, a brief summary of current knowledge of a group.

Syntype. Every specimen in a type-series in which no holotype was designated.

Systematics. The science dealing with the diversity of organisms.

Taxon. A taxonomic group that is sufficiently distinct to be worthy of being distinguished by name and to be ranked in a definite category.

Taxonomic category. Designates rank or level in a hierarchic classification. It is a class, the members of which are all taxa assigned a given rank.

Taxonomic character. Any attribute of a member of a taxon by which it differs or may differ from a member of a different taxon.

Taxonomy. The theory and practice of classifying organisms.

Topotype. A specimen collected at the type-locality.

Tribe. A taxonomic category intermediate between the genus and the subfamily.

Trinominal nomenclature. An extension of the binominal system of nomenclature to permit the designation of subspecies by a three-word name.

Triploblastic. Having the body organised from three embryonic layers of cells; ectoderm, mesoderm and endoderm.

Type. A zoological object which serves as the base for the name of a taxon.

Type designation. Determination of the type of a genus under Articles 67-69 of the Code.

Type-locality. The locality at which a holotype, lectotype, or neotype was collected.

Type-species. The species which was designated as type of a nominal genus.

Uninominal nomenclature. The designation of a taxon by a scientific name consisting of a single word; required for taxa above species rank.

Univariate analysis. A biometric analysis of a single character.

Valid name. An available name that is not preoccupied by a valid senior synonym or homonym.

Variation, ecophenotypic. Variation caused by non-genetic response of the phenotype to local conditions of habitats, climate, etc.

Variety. An ambiguous term of classical (Linnaean) taxonomy for a heterogeneous group of phenomena including non-genetic variations of the phenotype, morphs, domestic breeds, and geographic races.

Vector. In malaria, any species of mosquito in which the *Plasmodium* completes its sexual cycle in nature and which is thus able to transmit the disease.

Vector, conditional. Species of mosquito known to transmit malaria but presumed to be incapable of maintaining endemic malaria in the absence of more efficient vectors.

Vector, principal. Species mainly responsible for transmitting malaria in any particular circumstances. Principal vectors may overlap or may alternate seasonally.

Vector, secondary. Species thought to play a minor role in transmission in association with a principal vector and to be capable of maintaining malaria at a reduced level in the absence of the latter.

Vector control. Measures of any kind directed against a vector of disease and intended to limit its ability to transmit the disease.

Vector efficiency. Ability of a mosquito species, in comparison with another species in a similar climatic environment, to transmit malaria in nature. A rough estimate of relative efficiency may be made by comparison of sporozoite rates taken in comparable conditions.

Vernacular name. The colloquial designation of a taxon.

Vertical classification. Classificaton which stresses common descent and tends to unite ancestral and descendant groups of a phyletic line in the single higher taxon, separating them from contemporaneous taxa having reached a similar grade of evolutionary change.

Zone. In malaria eradication terminology, a territorial and administrative operational unit responsible for the operation, evaluation and administration of the field programme in its areas, which often coincides with an administrative division of the country. The zone office is normally under the direction of a senior professional officer, responsible for execution of all operations and routine evaluation of results in the zone.

Zoological Nomenclature. International Code of rules established by the International Commission on Zoological Nomenclature and periodically revised.

Zoonosis. Disease or infection common to man and other vertebrates and naturally transmitted between these hosts.

Zoophilic. Term applied to mosquitoes showing a relative preference for non-human blood even when human hosts are readily available.

Source: WHO, 1963; Mayr, 1978; Cratchley, 1980

Indian Anophelines is the first book of its kind on the fauna of anopheline mosquitoes from India. The following aspects of mosquito systematics, biology and distribution are described:

Worldwide distribution of anophelines in 12 malaria epidemiological zones; Reported distribution of anophelines in India; Bio-ecology and behaviour of mosquitoes; Updated vector status; Pictorial keys; Bibliography; and Glossary.

Indian Anophelines assume special importance because of the deteriorating malaria situation in India, complicated by vector resistance to insecticides, ecological succession of mosquitoes, invasion of mosquitoes to new areas, as also their disappearance from certain areas. As a result mosquito fauna has undergone major changes and this precise knowledge at the local level in endemic regions is invariably lacking. Often the identification is made difficult due to variations in many appendages. For each anopheline species the book provides names, derivatives, type form availability, resting habits, breeding ecology, biting time, flight range, susceptibility to insecticides, relation to disease, reported distribution in India and the world, and results of vector incrimination studies. Using this book it is easy to identify specimens correctly up to species level. Taxonomic description of each species is supported by high quality illustrations giving distinguishing features of each species and their variations. The style of presentation is lucid and simple. This book is intended as a reference material for students of mosquito systematics. The book therefore would be a valuable addition in the libraries and a source of knowledge for the students engaged in research and those interested in the study of the bioecology and control of mosquitoes.

Dr. B.N. Nagpal did M.Sc. Zoology (entomology) in 1979 from Allahabad University, and joined the Malaria Research Centre as Research Fellow. He obtained Ph.D. from Berhampur University in 1986 for his thesis on "Mosquitoes of Orissa" under the guidance of Dr. V.P. Sharma. He has extensively surveyed large endemic areas of the country for the collection of mosquitoes and has studied in depth their bioecology under natural conditions. Based on his field-collected specimens a museum on mosquitoes has been established at the MRC. The museum contains valuable mosquito specimens of type form and variations found in the field. This book is an outcome of his 15 years of field work supported by laboratory investigations on mosquito systematics.

Dr. V.P. Sharma is D.Phil. and D.Sc. from Allahabad University. He is fellow of learned societies, FNA, FNASc, FAMS, FRAS, and has published more than 200 research and review papers in national and international journals. The first director of the Malaria Research Centre, Dr. Sharma has raised it to the status of an important national laboratory in less than a decade. Dr. Sharma is well known for the development of bioenvironmental malaria control strategy—he has developed a strategy which has found wide application in managing malaria in the field. He has received several awards—Inventions award of Government of India (1971), B.K. Srivastava Oration award (1981), Om Prakash Bhasin award (1985), R.V. Rajam Oration award (1987), M.L. Gupta Trust award (1989), B.N. Singh Oration award (1990), Ranbaxy award (1990), and MOT Iyengar award (1990). He was honoured as Padma Shri in 1992. Dr. Sharma is Chairman, Panel of Experts on Environmental Management for Vector Control (PEEM) of the World Health Organization (WHO); Council Member of the International Congress of Entomology; Consultant to WHO on several occasions; and Board Member of the Malaria Foundation Incorporated, New York.

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