

DESCRIPTION OF A NEW SPECIES OF *CULEX* (*LOPHOCERAOMYIA*) FROM ORISSA, INDIA

R. NATARAJAN AND A. R. RAJAVEL¹

Vector Control Research Centre (ICMR), Indira Nagar, Pondicherry 605 006, India

ABSTRACT. Female and male adults, male genitalia, pupae, and larvae of *Culex* (*Lophoceraomyia*) *singhbhumensis*, a new mosquito species, are described from Orissa, India.

KEY WORDS Culicidae, *Culex*, *Lophoceraomyia*, new species, India

INTRODUCTION

The revision of the subgenus *Lophoceraomyia* Theobald of the genus *Culex* Linnaeus by Sirivanakarn (1977) included 58 species for the Oriental region. Of these, 14 species were reported to occur in India. Subsequent additions to India were *Cx. lasiopalis*, *Cx. raghavani*, *Cx. pholeter* (Reuben et al. 1993), *Cx. quadripalis* (Bhattacharyya et al. 2003), and *Cx. wilfredi* and *Cx. pilifemoralis* (Rajavel et al. 2005a). We describe here a new species in the subgenus *Lophoceraomyia*, from the eastern hill range of India. The morphological terminology of Sirivanakarn (1977) is followed.

Culex (*Lophoceraomyia*) *singhbhumensis* sp. nov.

Female. Wing: 2.7 mm. Forefemur: 1.7 mm. Proboscis: 1.9 mm. Medium-sized brownish species. **Head:** Decumbent scales in center of vertex very narrow, linear, and predominantly pale whitish; erect scales slender, entirely black; lateral patch of broad scales at side of eye white and very distinct. Palpus slender, dark-scaled, 0.2 of proboscis length. Proboscis dark, slender, and slightly longer than forefemur; labial basal setae weak, hairlike, usually 2–4 in number. Antenna shorter than proboscis. **Cibarial armature:** Cibarial bar with a close-set row of about 35 elongate and abruptly pointed teeth. **Thorax:** Mesonotal integument dark brown; mesonotal scales narrow, curved, moderately dense, entirely dark brown; acrostichal bristles absent except on extreme anterior promontory; dorsocentral, supraalar, and scutellar bristles well developed, strong, dark brown; anterior pronotum with short setae and bristles only; posterior pronotum entirely bare. Pleuron slightly paler or concolorous with mesonotum, without distinct scale patches, lower mesepimeral bristles absent. **Legs:** Anterior surface of hind femur with a broad pale stripe extending from base to apex. **Wing:** Scales dark, narrow, and relatively dense on all veins; plume

scales on veins R2, R3 rather narrow, linear. **Abdomen:** Terga entirely dark; basolateral pale spots or band absent; sterna pale-scaled.

Male. Essentially as in female, differing in smaller size and scantier scales on the wings. **Palpus:** Long, slender, about equal to proboscis; segment 1 without finger-like processes on lateral and ventral surfaces; segment 3 with ventral rows of short, tiny setae; segments 4 and 5 weakly plumose. **Proboscis:** Slender; false joint absent; sinuous setae absent; lateral and ventral surfaces with a few rows of short setae, widely spaced along whole length; labial basal setae spinelike, 8–10 in number. **Antenna:** Pedicel smooth, round, with distinct nipple-like spiculate prominence on inner dorsal surface; flagellum moderately long plumose; flagellomeres 5–10 without modified tufts of scales and setae (Figs. 1a, 1b).

Male genitalia. **Segment IX:** Tergum narrow, lateral lobe small, poorly developed, with 4–5 moderately strong setae; sternum broad, with regular row of 5,6 moderately strong setae towards caudal margin. **Basimere:** Conical in shape; moderately strong bristles confined to lateral tergal surface; inner tergal surface without submarginal setae (Fig. 1c); a group of 20–25 hairlike setae in the apical margin of the basimere. **Subapical lobe:** Prominent, not clearly divided into proximal and distal parts, all specialized setae and leaflets in proximal and distal parts present; proximal part with 3 stout, subequal rodlike setae (*a–c*); seta *a* most conspicuous, being strongly sclerotized and curved at middle (Fig. 1d); seta *b* deeply curved medially, and seta *c* gently curved; distal part with 2 bladellike and 3 hairlike setae in group *d–f*; leaflet *g2* strong, long, distally bent, and pointed; leaflet *g1* striated, apex acuminate; seta *h* moderate. **Distimere:** Somewhat erect with basal 0.5 moderately swollen and apical 0.5 conical (Fig. 1d). **Phallosome:** Internal process simple, curved tergal, and not projecting beyond apex of external process (Fig. 1e); external process without strong denticles; apical lobe of external process small and spiculate. **Proctiger:** Crown dark, large, consisting of a number of strong flat

¹ To whom correspondence should be addressed.

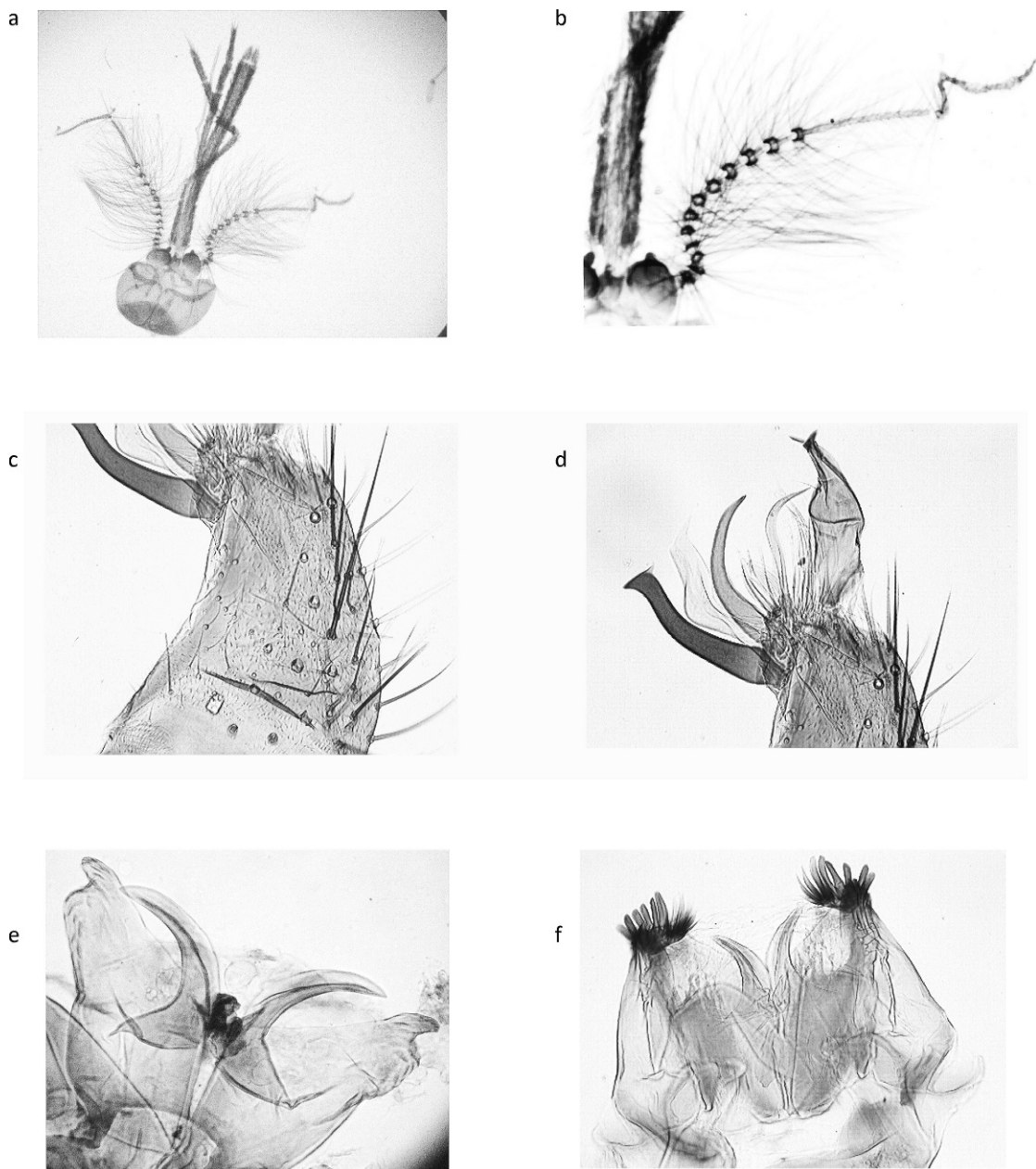


Fig. 1. *Culex (Lophoceraomyia) singhbumensis* sp. nov. male. (a) Head showing proboscis, palpi, and antennae. (b) Antenna. (c) Basimere. (d) Leaflets of basal lobe and distimere. (e) Internal and external processes of phallosome. (f) Crown of proctiger.

and blunt spicules laterally and fine spicules mesally (Fig. 1f); paraproct short and pigmented; cercal setae 2–4 in number.

Pupa. Abdomen: 2.9 mm. Paddle: 0.67 mm. Trumpet: 0.66 mm, index 7–8. *Trumpet*: Dark brown, cylindrical, index 5.5–7.0; pinna same diameter as meatus or slightly flared towards apex, slit not extending to meatus (Fig. 2c). *Cephalothorax*: Moderately pigmented; 8-C single

or double; 9-C 1,2-branched. *Metanotum*: Seta 10-C double, rarely with 4 branches; 11-C usually double (2–4). *Abdomen*: 5-IV–VI bifid, rarely single, about 1.75 times the length of succeeding abdominal segments; 6-III–VI double; 1-II short, multiple branches (18–20). *Paddle*: Ovoid with minute, widely spaced serrations on basal 0.5 of outer margin only; seta 1-P single (Fig. 2d). Chaetotaxy given in Table 1.

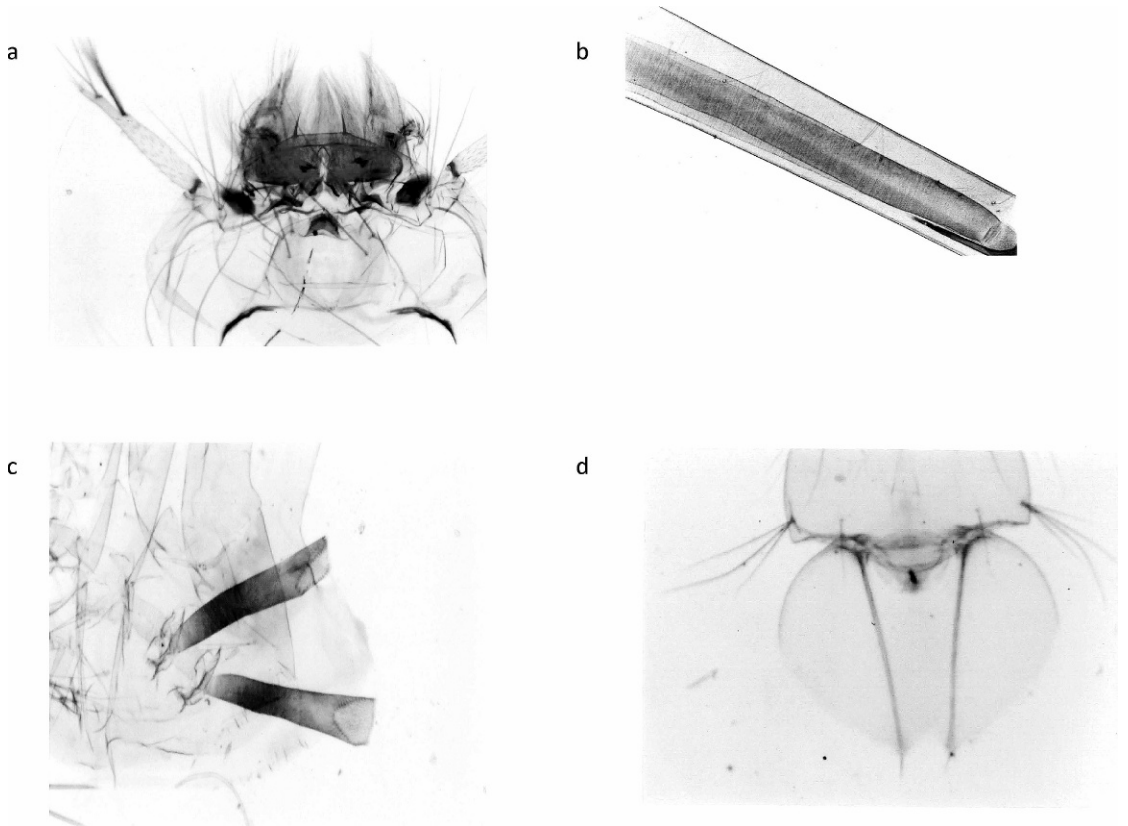


Fig. 2. *Culex (Lophoceraomyia) singhbumensis* sp. nov. (a) Head of larva. (b) Siphon of larva. (c) Trumpets of pupa. (d) Paddle of pupa.

Larva. Head: 0.74 mm. Siphon: 1.4 mm; index 5,6. Saddle: 0.28 mm; siphon/saddle ratio 4,5. *Head:* Pale yellowish without spicules, wider than long; seta 1-C dark, spiniform; 4-C single, posteriad of 7-C, anteriad to 6-C, length more

or less equal to distance between bases of the pair; 5-C stout, long, barbed, always single, occasionally double in one side only, more than 1.25 of 7-C, well posteriad to 4-C; 6-C always single, long, barbed, equal to 5-C, closer to 4-C than 5-C

Table 1. Number of branches for setae of pupa of *Culex (Lophoceraomyia) singhbumensis* (5 specimens, modes in parentheses).

Seta no.	Cephalothorax	Abdominal segments							
		I	II	III	IV	V	VI	VII	VIII
0	—	—	—	—	—	—	—	—	—
1	2-3 (2)	7-12 (10)	18-20	3-8 (5)	3-6 (3)	2-4 (3)	2	1-2 (2)	—
2	1-4 (2)	1	1-2 (1)	1	1	1	1	1	—
3	2-3 (2)	2	2	2-4 (2)	4-7 (6)	2	1-2 (2)	1-2 (2)	—
4	2-3 (2)	2-7 (4)	4-5 (4)	3-5 (4)	1-4 (2)	4-6 (5)	2-3 (2)	1	1-2 (1)
5	1-3 (2)	2-5 (3)	2-3 (2)	1-2 (2)	1-2 (2)	1-2 (2)	1	1	—
6	2-4 (2)	1	1	2	2	1-2 (2)	2	4-6 (5)	—
7	1-2 (2)	2-3 (2)	2	2-6 (3)	1-4 (3)	2-8 (4)	1	1	—
8	1-2 (2)	—	—	2-6 (3)	1-3 (2)	1-4 (3)	1-3 (3)	2-4 (3)	—
9	1-2 (1)	1-2 (1)	1	1	1	1	1	2-3 (2)	2-6 (3)
10	2-4 (2)	—	—	1-3 (2)	1-3 (2)	1	1	1-2 (1)	—
11	2-4 (2)	—	—	1-2 (1)	1-2 (1)	1	1-2 (1)	1-3 (2)	—
12	1-3 (2)	—	—	—	—	—	—	—	—
13	—	—	—	—	—	—	—	—	—
14	—	—	—	1	1	1	1	1	1

(Fig. 2a); 8-C with 2-5(3) branches, longer than 9-C; 14-C bifid, sometimes split into 2,3 branches above the base; mental plate with 7-8 strong lateral teeth on each side of median tooth. Antenna shorter than head; basal 0.5 of shaft with numerous strong spicules; dark band at base; seta 1-A large, fan-shaped, multiple- (25-28) branched; 2,3-A long, bristlelike, situated subapically (Fig. 2a). *Thorax*: Integument light to moderately spiculate, sometimes absent; 3-P always single, reduced to 0.25-0.5 of length of 1,2-P; 4-P strong, subequal to 1,2-P, always double, rarely single on one side only, lightly barbed; 7-P strong, always double; 8-P single, subequal to 7-P; 14-P double occasionally with 3 branches on one side; 1-M single, short, about 0.5 length of 3-M. *Abdomen*: Integument lightly to moderately spiculate; 6-I,II stout, pectinate with 3 branches, middle one always subequal; 7-I stout, long, barbed with 2 branches, occasionally single on one side; 6-III-VI weakly barbed with 2-4 branches; comb scales 50-60, forming a triangular patch, each with rounded apical fringe; 2-VIII always single; saddle complete, short, moderately pigmented, marginal spicules absent; anal papillae 2 pairs, slightly longer than saddle, blunt-tipped. *Siphon*: Relatively long, thin, pigmentation varying from pale to light yellowish; acus well developed, index 5.5-6.0; pecten teeth 8-11, basal 1-2 large teeth barbed with 8 graded denticles; subventral tufts 5 pairs, sometimes 9, 2-branched each, shorter than siphonal width at point of attachment (Fig. 2b). Range and modal number of branches in Table 2.

Egg. Unknown.

Type series

The holotype male (A10396) with associated larval (ls2478) and pupal (ps2478) exuviae mounted on 1 slide, antenna and genitalia dissected and mounted on 1 slide (G10396), and the allotype female (A10508) with associated larval (ls2482) and pupal (ps2482) exuviae mounted on the same slide are deposited in the National Museum of Natural History (NMNH), Smithsonian Institution, Washington, DC. They bear the following collection data: India, Orissa, Keonjhar District, Mamalapusi, altitude 2300 ft, collection date 29.9.2004, collected as larva from crab hole along stream margin, Coll. R. Natarajan.

Paratypes. One male (A10564) with associated larval (ls2446) and pupal (ps2446) exuviae mounted on 1 slide and dissected antenna and genitalia (G10564) on 1 slide bearing collection data: India, Orissa, Keonjhar District, Badagosda, collection date 28.9.2004, collected as larva from seepage of stream, and 1 female (A10584) with associated larval (ls2486) and pupal (ps2486) exuviae on 1 slide and genitalia

Table 2. Number of branches for 4th-stage larva setae of *Culex (Lophoceraomyia) singhbhumensis* (5 specimens, modes in parentheses).

Seta no.	Abdominal segment											
	Head	Thorax					Abdominal segment					
		P	M	T	I	II	III	IV	V	VI	VII	VIII
0	1	—	—	—	—	1	1	1	1	1	1	1
1	1	1	—	—	1	1-3 (1)	2-3 (3)	2-3 (3)	2-5 (4)	1-2 (1)	1-3 (3)	1-3 (3)
2	—	1	3-6 (4)	2-3 (2)	1	1-2 (2)	1	1	1	1	1-3 (1)	1
3	1	1	1	3-6 (4)	2-4 (2)	1-2 (2)	1-3 (1)	1-2 (2)	1	1-3 (3)	1-4 (2)	6-9 (6)
4	1	2	2-4 (2)	3-5 (4)	5-8 (8)	4-6 (5)	1-5 (2)	1-2 (1)	2-6 (5)	2-3 (2)	1	1
5	1	1	1	1	2-7 (3)	1-3 (2)	1-4 (1)	1-2 (2)	1-3 (3)	1-3 (3)	2-4 (2)	2
6	1	1	1	1	3	2-3 (3)	2	2-4 (3)	2-3 (2)	2	5-10 (6)	1
7	4-6 (5)	2	1	5-7 (7)	1-2 (2)	3-7 (3)	4-6 (5)	4-6 (5)	4-7 (5)	2-4 (3)	1-3 (1)	1
8	2-5 (3)	1	4-6 (5)	—	—	1-2 (2)	2	1-2 (2)	2	2-3 (3)	2-4 (2)	1-S 2
9	4-5 (5)	1	3-5 (4)	5-6 (5)	1-3 (2)	1	1	1	1	1	2-9 (6)	1-X 3
10	3-4 (3)	1	1	1	1-3 (2)	1	1-2 (1)	1	11	1	1-2 (2)	2-X 2-3 (2)
11	4-8 (6)	3-9 (4)	2-4 (3)	2-3 (3)	2-6 (3)	1-5 (3)	2-3 (2)	1-4 (2)	1-2 (2)	1-3 (1)	2-4 (2)	3-X 1
12	5-8 (7)	1	1	2	2-3 (3)	2-3 (2)	1-3 (2)	2-3 (2)	1-3 (2)	1-3 (1)	3-6 (6)	—
13	5-10 (6)	2	—	7	2-6 (2)	7-13 (8)	1-3 (3)	2-4 (3)	—	—	1	—
14	2	2	—	—	—	—	1	1	1	1	—	—
15	5-10 (6)	—	—	—	—	—	—	—	—	—	—	—

P = prothorax; M = mesothorax; T = metathorax.

(G10584) on 1 slide bearing collection data: India, Orissa, Keonjhar District, Mamalapus, collection date 29.9.2004, collected as larva from crab hole along stream margin. They are also deposited in the NMNH, Smithsonian Institution, Washington, DC. One male (A6183) with associated larval (ls1643) and pupal (ps1643) exuviae on 1 slide and antenna and genitalia (G6183) on 1 slide with collection data: India, Orissa, Keonjhar District, Dhankuniasahi, collection date 28.8.2003, collected as larva from crabhole along stream margin; 2 males (A10578; A10585) with associated larval (ls2447; ls2448) and pupal (ps2447; ps2448) exuviae and dissected genitalia (G10578; G10585) mounted on slides, and 1 female (A10586) with associated larval (ls2445) and pupal (ps2445) exuviae on slide, with collection data: Badagosda, 28.9.2004, collected as larvae from seepage of stream; 1 female (A10575) with associated larval (ls2485) and pupal (ps2485) exuviae mounted on 1 slide; 1 female (A10509), 2 larval (ls2483; ls2477) exuviae, and 1 pupa (p2477) mounted on slides, with collection data: Mamalapus, 29.9.2004, collected as larvae from crab hole along stream margin. They are deposited in the Mosquito Museum established at the Vector Control Research Centre (Rajavel et al. 2005b).

Etymology

Description of this new species is based on material obtained from 3 villages, Mamalapus (21°33'49"N, 85°28'74"E), Badagosda (21°35'17"N, 85°25'30"E), and Dhankuniasahi (21°35'80"N, 85°24'86"E), located in the Keonjhar district of Orissa, India. These villages are located in the part of the eastern hill ranges of India known as Singhbhum hills. The species is named after these hills, known for their extensive forest cover and rich flora and fauna.

Bionomics

All specimens of this species were obtained as larvae from either crab hole along stream margin or from seepage of stream. *Culex* (*Lop.*) *bicornutus* (Theobald) was the only species found in association of this species in the crab hole. Nothing is known about the adult biology, behavior, and its medical importance.

Taxonomic discussion

Practically all *Lophoceraomyia* species have been recognized on the basis of the difference in male antenna, palpus, proboscis, and genitalia. The females of most species are difficult to identify except by correlation with the male through associated larval and pupal skins from individual rearing.

Because of the absence of modified tufts of setae on the antennal flagellomeres 5–10, the males of *Cx. singhbhumensis* are superficially similar to members of the subgenus *Culiciomyia* and *Eumelanomyia*. However, it can be differentiated from *Culiciomyia* by the absence of lanceolate scales on the 3rd and 4th male palpal segments and the characteristic shape of the phallosome and from *Eumelanomyia* by the absence of minor whorls of short setae distad of normal large whorls of large setae on flagellomeres 2–11, and the shape of the phallosome.

On the basis of the male phallosome, antennal pedicel, palpus, and proboscis, subgenus *Lophoceraomyia* is divided into 3 major groups, namely, the *Fraudatrix* group, the *Mammilifer* group, and the *Wilfredi* group. *Culex singhbhumensis* can be readily distinguished not only from other subgenera of *Culex*, but also from the *Fraudatrix* and *Wilfredi* groups of subgenus *Lophoceraomyia*, by the presence of spiculate prominence on the inner dorsal surface of the antennal pedicel, which is characteristic of the *Mammilifer* group of the Oriental region.

Among the *Brevipalpus* and *Mammilifer* subgroups of the *Mammilifer* group, based on the presence of leaflet g1 of subapical lobe of male genitalia and by the placement of setae 2,3-A subapically in the larva, and on the basis of the larval breeding habitat, *Cx. singhbhumensis* is placed in the *Mammilifer* subgroup.

Sirivanakarn (1977) classified the Oriental species of the *Mammilifer* subgroup into 8 complexes: *impostor*, *traubi*, *mammilifer*, *ganapathi*, *minor*, *peytoni*, *pholeter*, and *flavicornis*. Of these, only the *impostor* complex is characterized in the male by the absence of modified tufts of scales and setae on the antennal flagellum. Though *Cx. singhbhumensis* shares this character, it differs in the male genitalia by absence of submarginal setae of basimere, internal process of the phallosome not longer than the external process; in the larva by 5-C always single, and siphon with 5 pairs of tufts, each with 2 weak branches; and is therefore excluded from this complex. On the basis of the following characters that are typical only of this species—erect distimere with basal half moderately swollen and apical half conical, seta *a* of the subapical lobe of basimere strongly sclerotized and curved at middle—we place *singhbhumensis* in its own complex, separated from the other complexes of the *Mammilifer* subgroup.

ACKNOWLEDGMENTS

We thank P. Jambulingam, Director, Vector Control Research Centre (VCRC), and P. K. Das (former Director, VCRC) for their support for the mosquito biodiversity studies during which

specimens of this new species were collected. We thank S. S. Sahu, Officer-in-charge, VCRC Field Station, Orissa, for facilitating mosquito survey in the area.

REFERENCES CITED

- Bhattacharyya DR, Prakash A, Mohapatra PK, Mahanta J. 2003. Occurrence of *Culex (Lophoceraomyia) quadripalpis*, *Culex (Lophoceraomyia) mammifer* and *Uranotaenia (Pseudoficalbia) novobscura* in Assam, India. *J Am Mosq Control Assoc* 19:13–14.
- Rajavel AR, Natarajan R, Vaidyanathan K. 2005a. Mosquito collections in the Jeypore hill tracts of Orissa, India, with notes on three new country records, *Culex (Lophoceraomyia) pilifemoralis*, *Culex (Lophoceraomyia) wilfredi*, and *Heizmannia (Heizmannia) chengi*. *J Am Mosq Control Assoc* 21: 121–127.
- Rajavel AR, Natarajan R, Vaidyanathan K, Soniya VP. 2005b. A list of the mosquitoes housed in the mosquito museum at the Vector Control Research Centre, Pondicherry, India. *J Am Mosq Control Assoc* 21:243–251.
- Reuben R, Tewari SC, Hiriyan J. 1993. Studies of the mosquito fauna of south India. In: Coetzee M, ed. *Entomologist extraordinary: a festschrift in honor of Botha de Meillon*. Johannesburg, South Africa: South African Institute of Medical Research. p 47–50.
- Sirivanakarn S. 1977. Medical entomology studies. VI. A revision of the subgenus *Lophoceraomyia* of the genus *Culex* in the Oriental region (Diptera: Culicidae). *Contrib Am Entomol Inst (Ann Arbor)* 13: 1–245.