Mosquito is a Spanish word meaning "little fly", and its use dates back to about 1583. Before then, they were called "biting flies" in English, but the term "mosquito" was adopted to prevent confusion with the house fly. The word derives from Sanskrit maksh (fly) via the Latin word musca (fly) and the Italian moschetta or Spanish mosquito (little fly). The oldest known mosquito with a basically modern anatomy was found in 79 million year old Canadian amber and is considered as the first undeniable record of this group from the Cretaceous Period (Poinar et al. 2000). Culiciformes Meigen, 1818 is the earliest family group name that established the date of priority for Culicidae and all mosquitoes are today placed in the Family Culicidae. However, it was Linnaeus (1758) who first gave the scientific name to mosquitoes by erecting the genus Culex to include what he considered as mosquitoes. Of these only two are known today as true mosquitoes and have valid names, viz: Culex pipiens L. 1758 and Aedes aegypti (L.) 1762. The latter had actually been named Culex aegypti by Linnaeus. The family Culicidae is a large and abundant group which occurs throughout temperate and tropical regions of the world, and well beyond the Arctic Circle. The family today includes 3,524 species which are divided among two subfamilies and 113 genera. The subfamily Anophelinae has three genera and Culicinae has 110 genera divided between 11 tribes. This current taxonomic status of mosquitoes is the outcome of numerous faunal studies and taxonomic revisions that have been done by several workers over the past decades, probably starting from the time of Linnaeus himself.

Taxonomic History and Classification of Culicidae

As insects, the mosquitoes besides being a group of interest to the entomologists, gained considerable significance as carriers of disease, with the classical discoveries of Manson (1879), Ross (1899) and Reed and Carroll (1901) that established their involvement in the transmission of filaria, malaria and yellow fever, respectively. The impetus given by these discoveries led to intensive studies to record the species diversity of mosquitoes in different regions of the world which resulted in the publication of several monographs and catalogues. Brunetti (1907) compiled an
annotated catalogue to provide a systematic list of the mosquitoes recorded from the Oriental Region, which included works spanning from that of James (1889) to Banks (1906). This catalogue also includes the work on the “Anopheles Mosquitoes of India” by James and Liston (1904) that deals with the distribution and classification of Indian species of Anopheles, besides providing notes on the eggs, larvae, habitats, collecting, mounting and preserving of specimens. Contemporary to this catalogue is the monograph of Culicidae of Malaya published by Leicester in 1908.

The British Museum (Natural History) employed Fred. V. Theobald in 1899 whose work by its magnitude holds prior place in the literature of family Culicidae. As a consequence of his studies many new generic names were introduced in an effort to classify numerous new species into seemingly natural groups. Beginning from his report on the collections of mosquitoes received at the British Museum in 1900, Theobald went on to publish between 1901 and 1910 the 5 volumes of ‘A Monograph of the Culicidae or mosquitoes’. This monograph provides a lengthy list of works and essays, extensive information on life history, food, habitat, natural enemies and geographical distribution of the mosquitoes of the world. Nevertheless, the splitting of mosquitoes into many genera by Theobald who placed the 1,050 species known to him in 149 genera rendered his classification neither practical nor natural.

Significant changes were made toward a much more conservative system of classification during the following two decades. This was possible due to the extensive collections and descriptions of mosquitoes made during this period, remarkable among them being the works of Edwards who published a series of papers from 1911 to 1932. Notable among these works were the “Synopsis of the species of African Culicidae other than Anopheles” (Edwards, 1912), “Revision of the mosquitoes of the Palearctic region” (Edwards, 1921), “Synopsis of adult Oriental Culicine mosquitoes” (Edwards, 1922a, 1922b), “Synopsis of the adult mosquitoes of the Australian region” (Edwards, 1924) and the compendium of all his works published as the “Genera Insectorum. Family Culicidae” (Edwards, 1932). In this master treatment Edwards included the study of immature stages as well, along with the biological characteristics of the species that made it possible for him to develop a conservative system of classification of Culicidae, thus reducing the enormous number of generic names in use to a relative few. This treatment placed all the vectors
of human malaria in the genus *Anopheles* rather than in many genera recognized by Theobald and also accorded the same treatment to *Culex* and *Aedes*, reducing the number of genera from 149 to 30.

Almost during the same period, mosquitoes of the Oriental region, particularly that of the British India, were investigated extensively by Barraud who brought out “A Revision of the Culicine Mosquitoes of India” in 26 parts through publications spanning from 1923 to 1929. In these revisions many new species were described, besides descriptions made of larvae for many of the species. He compiled his work and including the treatment of Culicidae by Edwards (1932) and Senior White (1923), published his classical volume of ‘Diptera. Family Culicidae’, in the “Fauna of British India including Ceylon and Burma” (Barraud, 1934). It was during this period that biological characteristics became an important element in the classification giving rise to the concept of the biological species in mosquito classification.

The comprehensive works of Howard, Dyar and Knab (1912-1917), Dyar (1928) and Matheson (1944) contributed to the knowledge of mosquitoes of North America, but it was Carpenter and LaCasse (1955) who brought together this information in the form of a monograph to fulfil the need of the systematic entomologist. The arrangement of genera and species in this monograph closely followed the classification of Edwards (1932). Belkin, while reviewing the crab-hole mosquitoes of the Neotropical region, realized that the knowledge of the mosquitoes found in the New World tropics was very limited. He therefore organized a project on the “Mosquitoes of Middle America” that began in 1962 and continued till 1980 and through which many papers on Neotropical mosquitoes were published.

Belkin’s contribution to the classification of Culicidae was, however, made much earlier when he published the monograph on “Mosquitoes of the South Pacific” (Belkin, 1962). This work is considered as the best example of a modern taxonomic study of an entire mosquito fauna as it includes all three levels of taxonomic study. There is alpha taxonomy, represented by the description of many new species, the resurrection of many species from synonymy, and description of many previously unknown stages. There is beta taxonomy, represented by the careful comparison of mosquito species and their classification into tribes, sections, genera, subgenera,
groups, and complexes. This classification was done largely on the basis of comparative morphology, but distribution and ecology also were taken into consideration. Finally, there is gamma taxonomy, represented by Belkin’s attempts to explain the evolution of the mosquito fauna of the South Pacific.

The value of the classification of Culicidae developed by Belkin (1962) and its robustness is evident from the following passage in the review of taxonomy, classification and phylogeny of Culicidae by Harbach (2007). “Edwards (1932) included dixid and chaoborid midge as subfamilies of Culicidae and regarded the ‘true mosquitoes’ as members of a third subfamily, Culicinae. He recognized three tribes within Culicinae, i.e. Anophelini, Toxorhynchitini (as Megarhinini) and Culicini, and divided the tribe Culicini into five groups, i.e. Sabethes, Uranotaenia, Theobaldia, Aedes and Culex. Stone (1957) removed Dixidae and Chaoboridae from Culicidae and restricted family Culicidae to the Culicinae of Edwards (1932). This brought about changes in subfamily and tribal designations that were adopted by Stone et al. (1959) in their world catalogue of mosquitoes. This classification recognized subfamilies Anophelinae, Culicinae and Toxorhynchitinae, and two tribes within Culicinae, the Culicini and Sabethini. Belkin (1962) disagreed with this change and retained Edwards’ subfamily structure, but reorganized the classification of Culicinae (“true mosquitoes”) to include 12 tribes instead of three. He retained Anophelini and Toxorhynchitini and recognized ten tribes in place of Edwards’ Culicini. At least some authors (e.g. Belkin et al. 1970) continued to treat dixids and chaoborids as subfamilies of Culicidae until Knight and Stone (1977) once again excluded them from the family. This action resulted in the recognition of three subfamilies, i.e. Anophelinae, Culicinae and Toxorhynchitinae, and the division of subfamily Culicinae into the 10 tribes established by Belkin (1962). Mattingly (1969, 1971, 1981), however, was unwilling to accept the division of Culicinae into 10 tribes and consequently followed Stone et al. (1959) in recognizing only two, i.e. Culicini and Sabethini. Service (1993) utilized Mattingly’s tribal divisions as a matter of convenience, but for the most part mosquito taxonomists accepted all of the tribal groups introduced by Belkin, including Toxorhynchitini (Harbach & Kitching, 1998; Mitchell et al. 2002). Leaving aside the controversial proposals of Reinert et al. (2004, 2006) to divide tribe Aedini into 63 genera instead of 12, surprisingly few changes have been made in the recognition of mosquito genera since Edwards (1932)”.
Parallel to the Mosquitoes of the Middle America Project was the Southeast Asia Mosquito Project (SEAMP). Beginning in 1961, a major study of the mosquito fauna of Thailand was undertaken by the United States Army Medical Component – Southeast Asia Treaty Organization, Bangkok, in connection with studies on a number of mosquito-borne diseases. It rapidly became abundantly clear that a major revision of the mosquito fauna of the entire area would be needed. The SEATO collections became the nucleus for the Southeast Asia Mosquito Project. The Project was formally organized at the United States National Museum in October 1964 (De Meillon, 1969).

This project was instrumental in documenting valuable information of mosquitoes, many of them medically important, besides description of many of the unknown life stages of different species, and the distribution and ecology of many mosquito species. Such information together with the vast mosquito material accumulated for the study made it possible to bring out State or regional level revisions of mosquitoes like those of Bram (1967a), Delfinado (1967, 1968), Reinert (1970), Sirivanakarn (1972), and Huang (1972). Tanaka et al. (1979) made a revision of the mosquitoes of Japan (including the Ryukyu Archipelago and the Ogasawara Island) and Korea. Besides these, the mosquito fauna of the Philippines have been extensively covered in a monograph by Basio (1971). State and regional level revisions of mosquitoes are valuable and extremely useful to studies in mosquito biology and control in the particular areas involved and each can contribute valuable information to the overall picture of mosquito biology and distribution (Nielsen, 1980). So, not only in the Southeast Asian region, but also in other parts of the world such revision of mosquitoes have been done, like that of Evenhuis and Gon (1989) who updated the list of mosquito species in the Australian / Oceanic region to over 600 valid species.

Revision of mosquitoes at sub-generic level also gained prominence due to the importance of several subgenera being medically important. Reinert (1974) made a new interpretation of the subgenus *Verrallina* of the genus *Aedes*, while the subgenus *Anopheles* was revised in Thailand by Harrison and Scanlon (1975). A revision of the subgenus *Culex* in the Oriental region was done by Sirivanakarn (1976). Huang
(1977, 1979) made notable contributions on subgenus *Stegomyia* of genus *Aedes* in the Oriental region, while Huang and Hitchcock (1980) revised the *Aedes scutellaris* group of Tonga. A revision of the subgenus *Paraedes* of the genus *Aedes* was done by Reinert (1981). Eldridge (1974) observed that the taxonomy of mosquito vectors must be understood thoroughly before mosquito-borne diseases can be understood or controlled. Some of the group and subgroups of mosquitoes which are medically important have also been extensively studied in this regard. The subgroup *vishnui* in the subgenus *Culex* is comprised of important vectors of Japanese encephalitis (JE), the identification of which is very difficult. Reuben et al. (1994) studied this subgroup and prepared a key to identify the species of this complicated subgroup. Harrison (1980) has studied the important *minimus* group of Myzomyia series of subgenus *Cellia* and resolved the taxonomic status of the different species, together with the distribution and bionomics in Southeast Asia. Chen et al. (2002) carried out molecular and morphological studies on the *minimus* group in southern China and have elucidated its taxonomic, distributional and vectorial status. Another important group that comprises malaria vectors in Southeast Asia is the Leucosphyrus group, a taxonomic revision of which has been made by Sallum et al. (2006).

Among the revisions of several subgenera of genus *Culex* done by Sirivanakarn (1972, 1976, 1977), the revision of the subgenus *Lophoceraomyia* in the Oriental region (Sirivanakarn, 1977) is significant due to the reason that identification of the females of this subgenus is very difficult, particularly in the absence of associated larval material. Record of some unidentified species of this subgenus with natural infection of four arboviruses in Malaysia, Bakau (MM-2325), Ketapang (MM-2549), Bebaru (MM-2354) and Lahore (a strain of Bakau No.114) (Anon. 1960), intensified studies on this subgenus. Notable among them are of Colless (1965) in Malaya, Bram and Rattanarithikul (1967) in Thailand, and Sirivanakarn (1968) in New Guinea and Bismarck Archipelago.

With more than 520 viruses registered in the International Catalogue of Arthropod-Borne Viruses, somewhat less than half having biological relationships with mosquitoes, about 100 known to infect humans (Mullen and Durden, 2002), it is likely that several of the mosquito groups, other than the well known vectors, may be involved in the viral disease cycles. Such a possibility, in the light of the view that it is
probable that certain *Lophoceraomyia* species play an important role as a natural reservoir of arboviruses (Sirivanakarn, 1977), emphasises the need for revisionary studies of this subgenus in different parts of its distribution.

**Distribution of subgenus *Lophoceraomyia***

Based on extensive studies, Colless (1965) has postulated that the subgenus originated in Southeast Asia as a derivative of the stem that includes the subgenera *Neoculex, Mochthogenes* and *Culiciomyia*. Belkin (1962) considered the subgenus as significant in South Pacific Island and appears to replace *Neoculex* in the Indomalayan region and the tropical portion of the Australasian region.

The subgenus *Lophoceraomyia* is confined to the Old World and is predominantly Oriental, Indomalayan and Australasian in distribution (Belkin, 1962). The subgenus occurs over a large area, centered on Malaya, covering all the Oriental and Australasian regions (except New Zealand), and extending north into Japan and eastern China and east into Oceania (Colless, 1965). It also occurs in islands of the Western and South Pacific (Sirivanakarn, 1968). Majority of these occur in Southeast Asia and neighbouring areas where they form one of the common elements of the culicids of tropical rain forests and its westernmost limit appears to be in India and Pakistan and it has never been reported further to the west in the Middle East and the Ethiopian region (Sirivanakarn, 1977).

There are 111 species reported in different parts of its distribution covering Australia, Indonesia, Papua New Guinea, Solomon Islands, Timor, New Britain, New Ireland, China, Japan, India, Nepal, Pakistan, Singapore, Philippines, Sri Lanka, Cambodia, Taiwan, Thailand, Vietnam, Malaysia, Burma, New Hebrides, Caroline Islands, Bismarck Archipelago, Hongkong and Maldives Islands.

In the South Pacific region where mosquito species have been studied from early period (Paine and Edwards 1929, Iyengar 1955) only two species of *Lophoceraomyia* were known (Stone et al. 1959), but Belkin (1962) described ten new species in this region. Similarly in the New Guinea and Bismarck Archipelago region where only 11 species were known to occur (Brug 1932, King and Hoogstraal
1955, Colless 1959a), Sirivanakarn (1968) described 33 forms that included 21 additional new species and 3 new records for this region. In the Oriental region where the subgenus is more predominant, studies on mosquito fauna in different countries such as Malaya (Macdonald 1957, Colless 1965), Thailand (Bram and Rattanarithikul 1967, Delfinado 1967), Philippines (Basio 1971, Delfinado 1966), and Sri Lanka (Barraud 1934, Carter 1950) updated the species of *Lophoceraomyia* in different parts of the region, but it was Sirivanakarn (1977) who made a major revision, recognized 58 species of *Lophoceraomyia* from the Oriental region that included description of 9 new species.

**Taxonomic history and classification of subgenus *Lophoceraomyia***

Theobald (1905a) proposed *Lophoceraomyia* as a distinct genus, with *uniformis* Theobald, 1905 as its type and the only included species. The spelling of this name in the original reference is *Lophoceraomyia*, but this was altered later by Theobald, in his Monograph, to *Lophoceratomyia*. The latter spelling was followed up to Barraud (1934), but based on its priority, the spelling *Lophoceraomyia* came to be used by Mattingly (1949), and the same is followed until now. Many of the species that are now recognized as *Lophoceraomyia* were kept by Theobald (1905b) in his different genera such as *Culiciomyia*, *Cyathomyia*, *Philodendromyia*, and *Melanoconion*.

Edwards (1917) reduced the genus *Lophoceratomyia* to a subgenus of genus *Culex*. The subgenus was also subdivided into three groups by Edwards (1932) based primarily on the male antenna and palpus as follows:

- **Group A** (*minutissimus* group). Torus of male antenna without prominence; flagellomeres 5 to 7 without scale tufts; palpus simple.
- **Group B** (*fraudatrix* group). Torus of male antenna without prominence; flagellomeres 5 to 10 with scales tufts; palpus with a pair of basal processes.
- **Group C** (*mammilifer* group). Torus of male antenna with prominence; flagellomeres 5 to 7 with scales tufts; palpus reduced in length.

Later, Edwards (in Barraud 1934) suggested a modification of this scheme by combining groups A and B into one group (*fraudatrix*) and subdividing group C to
separate the pitcher plant breeding species from those which breed in rock pools, tree holes and bamboos.

Barraud (1934) suggested that the species of subgenus *Lophoceratomyia* may be classed in three groups, according to their breeding habits, and also due to the structural distinctions between these groups: (1) Those which breed only in ground pools and have the torus of male antenna simple, without blunt prominence on inner side; palpi of male longer than proboscis, with last two segments usually distinctly hairy; proboscis of male usually with a row of stiff bristles beneath at base. This group includes *minutissimus*, *seniori*, *cinctellus*, *rubithoracis*, and *fraudatrix* among Indian species. (2) Those which breed mainly in rock pools, tree holes, or bamboos, and have the torus of male antenna with a blunt prominence on inner side; palpi of male as long as proboscis or longer, but with few or no hairs at tip; male proboscis without stiff bristles at base beneath. This includes the remainder of the known Indian species. (3) Those which breed mainly or exclusively in pitcher plants, have a blunt prominence on inner side of torus of male antenna, and palpi of male shorter than proboscis and bare. This includes six Oriental species but none of these are known to occur in India.

Belkin (1962) in his treatment of subgenus *Lophoceraomyia* of the South Pacific followed the subdivisions of Edwards (1932) and recognized all the South Pacific species as belonging to group B (*fraudatrix* group). Further, he attempted to group the different species into complexes and considered that the South Pacific species of *Lophoceraomyia* fall into 4 or possibly 5 complexes: (1) the *buxtoni* complex, (2) the *bergi* complex, (3) the *solomonis* complex, (4) the *hurlbuti* complex, and (5) the Santa Cruz complex. He also considered that much of the speciation in the South Pacific *Lophoceraomyia* may have occurred through hybridization of members of the different complexes.

Colless (1965) in his study of subgenus *Lophoceraomyia* in Malaya preferred to recognize only two major groups, with the second divided into two subgroups. He felt that this scheme, although more complex, illustrates the trend towards increased specialization in morphology and larval habitat, without obscuring the fundamental cleavage into two groups which differ so markedly in morphology and biology. Group
A (fraudatrix Group) usually inhabit ground water and occur in Oriental and Australasian Regions, while Group B (mammilifer Group) inhabit containers (including rock pools, but rarely in ground water) and occur in Oriental region only. The Group B was subdivided into subgroup B1 (mammilifer Subgroup) inhabiting tree holes, bamboo stumps, palm axils, rock pools, etc. and subgroup B2 (brevipalpus Subgroup) whose habitat is the pitcher plants, or rarely in plant axils. In addition, Colless also considered that there are several well-marked groups to which the term “sibling species” might well be applied. He drew attention to the following groups: (a) variatus, cubitatus, (b) minor, bicornutus, (c) traubi, ganapathi, (d) brevipalpus, eminentia, lucaris, acutipalpus, for the reason that in each group, morphological differences are exceedingly slight, but, in the first three groups at least, there is evidence of distinct differences in larval habitat. He was of the view that they should provide useful subjects for research into the problem of how such sibling species originate and coexist in nature.

Sirivanakarn (1968) in his revision of the subgenus Lophoceraomyia in New Guinea and Bismarck Archipelago considered the subdivision of Lophoceraomyia into 2 major groups by Colless (1965) to be a sound one. However, he maintained that a great deal of diversity and discordance is evident within both groups, when features of all stages are considered as done in his study. He, therefore, recognized a number of more or less distinct species complexes representing what he believed to be separate lineages or phyletic lines and placed them in either the mammilifer or the fraudatrix group. The presence of a prominence or similar modification of the male torus, considered to be diagnostic for the mammilifer group by Edwards (1932) and Colless (1965) was regarded as being of secondary importance in the Australasian region by Sirivanakarn (1968). He observed that this particular character seems to be well developed in a limited number of lineages represented in the Oriental region but is absent in 3 species from New Guinea which share with mammilifer a number of much more basic and significant features in the male phallosome, palpus and proboscis. Thus the mammilifer group was considered to include several different lineages, only some of which are characterized by modifications of the male torus. Accordingly, in New Guinea the mammilifer group was considered to be represented by three distinct subgroups, namely, mammilifer, bolii and digoeelensis. The fraudatrix group was also considered to be comprised of at least 10 different complexes.
Sirivanakarn (1977) based his revision of the subgenus *Lophoceraomyia* in the Oriental region on the study of about 8,000 specimens and recognized 58 species. He considered these species to apparently fall into 3 natural groups: *Fraudatrix*, *Mammilifer* and *Wilfredi*, on the basis of the male phallosome, antennal pedicel, palpus and proboscis. He removed the species *wilfredi* from the *Mammilifer* Group and along with two other species formed the *Wilfredi* Group. The *Fraudatrix* Group was subdivided into 2 subgroups: *Minutissimus* and *Fraudatrix*. The latter was further split into 7 complexes: *seniori*, *cinctellus*, *rubithoracis*, *inculus*, *quadripalpis*, *variatus* and *alphus*. The *Mammilifer* Group was divided into 2 subgroups: *Mammilifer* and *Brevipalpus*. The *Mammilifer* Subgroup was again split up into 8 complexes: *impostor*, *traubi*, *mammilifer*, *ganapathi*, *minor*, *peytoni*, *pholeter* and *flavicorns* while the *Brevipalpus* Subgroup was divided into 5 complexes: *navalis*, *hewitti*, *jenseni*, *brevipalpus* and *curtipalpis*.

In his revision of the subgenus Sirivanakarn (1977) also made the following taxonomic changes: (1) synonymizing *pachecoi* Baisas 1935 with *quadripalpis* (Edwards 1914); (2) resurrecting *bicornutus* (Theobald 1910) from the synonymy with *minor* Leicester 1908 proposed by Bram (1967a); (3) synonymyzing *hui* Lien 1968 with *spiculosus* Bram and Rattanarithikul 1967; (4) synonymyzing *fuscosiphonis* Bram and Rattanarithikul 1967 with *demissus* Colless 1965 (5) synonymyzing *plantaginis* Barraud 1924 with *minor* (Leicester 1908); and (6) relegating *barkerii* (Theobald 1907), *berardi* (Borel 1926) and *mindanaoensis* Baisas 1935 to nomen dubia. Several new species were also recognized for the Oriental region: *alorensis* from Alor, Indonesia; *paraculeatus* from Sabah, Malaysia and the Philippines; *aestivus* from Sabah, Malaysia; *graciconis* from Peninsular Malaysia; *pairoji* from Thailand; *impostor* from North Borneo, Malaysia; *wardi* and *lasiopalpis* from Sri Lanka and *hirtipalpis* from northern Thailand. The classification of *Lophoceraomyia* into groups, subgroups and complexes by Sirivanakarn (1977) forms the backbone of the present day classification of the subgenus.

**Subgenus Lophoceraomyia in India**
Mosquitoes have been known from India from very ancient time, both as a cause of nuisance and human disease. Early mosquito records of the British India included Ceylon and Burma, and mainly comprised of collections made by Giles (1901), Liston (1901), James (1902), Cogill (1903), James and Liston (1904), Edwards (1932), Senior White (1923), and Covell (1927). Most of these pertained to the Anopheline species due to the severity of malaria in those days and the need for study of the mosquitoes that transmit malaria. An up to date account on the species and varieties of Anophelini recorded from the Indian area until 1933 was provided in the Fauna of British India volume by Christophers (1933). A similar treatment of the Culicini was done by Barraud (1934). Prior to this, in his revision of the Culicine mosquitoes of India published in 26 parts, the Indian species of the subgenus *Lophoceraomyia* has been dealt in Part 15 by Barraud (1924), which gives the earliest information on the species of this subgenus in India.

A total of 8 species of subgenus *Lophoceraomyia*, namely *minutissimus, fraudatrix* (as *fraudator*), *cinctellus, uniformis, mammilifer, minor, flavicornis* and *plantaginis* were recognized as occurring in India by Barraud (1924). From the localities in India, where each of these species have been recorded, it is evident that *uniformis, mammilifer* and *fraudatrix* were the earliest known species of *Lophoceraomyia* in India, as these have been collected in 1911 from Mount Harriet of the Andaman Islands. The earliest known type locality for *Lophoceraomyia* in India was that of *flavicornis* from the Nilgiri hills in 1915. Barraud (1934) added 2 more species, *seniori* and *rubithoracis* and 1 variety as *minor var. bengalensis* to the Indian list of *Lophoceraomyia*.

Further addition to the Lophoceraomyia of India was made only after a decade when Menon (1944) described a new species *parainfantulus*, which was however, later synonymised with *infantulus* by Mattingly (1949). Nearly after two decades Rahman et al. (1968) described a new species *raghavanii* from the Nilgiri hills. Sirivanakarn (1977) considered this as a nominal form but did not include it in his revision of the Oriental species as it was not possible for him to determine whether or not it is really distinct from *flavicornis* for want of material for study and due to the reason that the type locality for both the species were same. Later, however, the
identity of *raghavanii* as a distinct species was confirmed from collections made in the Silent Valley in the Western Ghats of India (Reuben et al. 1993).

Colless (1965) added *macdonaldi* to the list of Indian *Lophoceraomyia* from Golaghat of Assam and also elevated *minor* var. *bengalensis* to species status as *bengalensis*. He also suggested that *plantaginis* may be a synonym of *minor*, based on the characters of antenna and terminalia which he found to be identical with *minor*. He also maintained that most or all of Barraud’s specimens of “*minor***” used by him for comparison with *plantaginis*, belonged to the closely related *bicornutus*. Later, *plantaginis* was synonymized with *minor* by Sirivanakarn (1977).

In the course of examination of specimens deposited by the Southeast Asia Mosquito Project and types and topotype specimens from India in the British Museum (Natural History), for revision of the *Lophoceraomyia* in the Oriental region, Sirivanakarn (1977) added one more species, *peytoni* to the list of Indian *Lophoceraomyia* which had been collected from the Andaman Islands.

Barraud (1934) included *fraudatrix* in the list of Indian species of *Lophoceraomyia* based on the comparison with characters of the type material from New Guinea. Colless (1959a) drew the conclusion that *fraudatrix* is almost certainly confined to the Australasian Region and does not in fact occur in Malaya. In his revision of the subgenus in Malaya, Colless (1965) resurrected *variatus* as a distinct species, which was followed by Sirivanakarn (1977) who maintained that only *variatus* is present in the Oriental region. Accordingly, the *fraudatrix* of Barraud in India is truly *variatus* (Sirivanakarn, 1977).

Barraud (1934) included *minor* in the list of Indian *Lophoceraomyia* with a foot note to the effect that ‘the Indian specimens had a small dense patch of minute hairs on each side of the proboscis near base, and a number of longer curved hairs laterally and on under surface of proboscis before middle, characters which were not present in the Malayan specimens’ based on which he determined *minor*. Colless (1965) on examination of the specimens, maintained that Barraud’s (1934) records of “*minor***” from North Kanara and Bombay Deccan refer to *bicornutus*, and the footnote of Barraud (1934) clearly refers to that species.
The subgenus *Lophoceraomyia* in India thus included 15 species namely, *bengalensis, bicornutus, cinctellus, flavicornis, infantulus, macdonaldi, mammilifer, minor, minutissimus, peytoni, raghavanii, rubithoracis, senori, uniformis*, and *variatus*. Subsequent additions to *Lophoceraomyia* in India were from mosquito faunistic studies done by various workers in different parts of the country. From mosquito collections made in the Western Ghats, *lasiopalpis* was recorded from Nilgiri hills, Tamilnadu, and *pholeter* from Coorg, Karnataka by Reuben et al. (1993). In the Northeastern region, Bhattacharyya et al. (2003), recorded *quadripalpis* from mosquito collections made in Assam. Rajavel et al. (2005) recorded the occurrence of two species, *wilfredi* and *pilifemoralis* in the Jeypore hills tracts of Orissa and Rajavel and Natarajan (2008) added *inculus* from collections made in the Bhitarkanika mangroves of Orissa. A total of 21 species of *Lophoceraomyia* have been documented from India.

Among the various subgenera of genus *Culex*, the subgenus *Lophoceraomyia* ranks second with 111 species, next only to the subgenus *Culex* with 201 species worldwide. Barraud (1934) in his treatment of *Lophoceraomyia* stated that about 25 species are known in all of its distributional range and 10 species occur in India. The increase in the number of species from 25 to the currently known 111 species is phenomenal for this subgenus, compared to which the currently known 21 species for India is insignificant. Except for the few recent additions that have been made from collection of mosquitoes done for other studies, a concerted effort to update the species of *Lophoceraomyia* in India has not been made.

Further, certain uncertainties regarding the taxonomic status of few species of *Lophoceraomyia* in India need to be resolved. Sirivanakarn (1977) while synonymizing *plantaginis* with *minor* stated “the proposed synonymy of *plantaginis* Barraud from India with *minor* is only tentative but appears to be correct since the type-male which I examined and designated as lectotype perfectly agrees with *minor* in the characters of antenna, proboscis and genitalia. As described by Barraud (1924, 1934) and subsequently discussed by Colless (1965), *plantaginis* differs from *minor* in having basal pale bands on the abdominal terga. However, as the type was mounted in balsam and other specimens in the type-series were found to be a mixture of
different species, including *bicornutus*, it has not been possible to evaluate the taxonomic importance of this character. Further study of additional topotypic material is required in establishing the identity of *plantaginis*, but for the present, it appears justified to consider it as a synonym of *minor*. There is also a possibility that it may be conspecific with *bicornutus*, but without additional material, this problem cannot be resolved.” Furthermore, Sirivanakarn (1977) considered *minor* to be the most common form in Malaysia, southern Thailand, Indonesia and the Philippines but elsewhere in Southeast Asia and other parts of the Oriental region, it appears to be completely replaced by *bicornutus* to which it is most closely related.

Similarly, Sirivanakarn (1977) while maintaining that it is not possible to determine whether or not *raghavanii* is really distinct from *flavicorinus*, since specimens of *raghavanii* were not available for his study, considered that it is possible that the larva of *raghavanii* is incorrectly associated and belongs to *uniformis*. Although, Reuben et al. (1993) confirmed the identity of *raghavanii* as a distinct species in India, the doubt regarding its larval identity remains to be resolved.

Barraud (1934) in his description of *minutissimus* added a footnote that ‘the only other Oriental species with similar characters is *infantulus*, which differs slightly in male hypopygium’. He did not however, record *infantulus* in India, though he found *minutissimus* to be fairly common from the Punjab to Orissa, and through Peninsular India to Ceylon. Sirivanakarn (1977) who included India in the distribution record of *infantulus*, observed that ‘it is possible that some of the previous records of *minutissimus* from several localities in India by Barraud (1924, 1934) are actually *infantulus*”. The distribution of these two species in India is therefore a topic of interest.

It is obvious that these shortcomings need to be addressed and therefore, a revision of the subgenus *Lophoceraomyia* in India is attempted in this study with the following objectives, (1) to validate the species of subgenus *Lophoceraomyia* occurring in India, (2) to diagnose, describe and illustrate all available stages of different species of the subgenus, and (3) to revise and formulate keys for identification of all Indian species of the subgenus.