

## ACTIVITIES

Current Study of Genus Culex in Southeast Asia(Diptera: Culicidae)<sup>1</sup>

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The genus Culex is not only one of the most dominant in terms of number of species and individuals but also one of the most complex and difficult genera among the mosquitoes of Southeast Asia. In a recent preliminary study a rough estimate of between 120-130 species, both previously recognized and new, have been seen from the area. They are distributed among 7 subgenera as follows: Neoculex with 5 species; Mochthogenes with 14-15 species; Lophoceraomyia with 48-50 species; Culiciomyia (including Thaiomyia) with 17 or more species; Acalleoemyia with 1 species; Culex with 36-38 species and Lutzia with 2-4 species.

The above figures are based on the reexamination of specimens, including the types and topotypical material, mainly from Malaysia, Thailand and the Philippines, as well as on a few from Cambodia, Vietnam, Taiwan, India, Burma, Ryukyus, Indonesia and other adjacent areas. There is a strong indication in the present study that considerably more species still remain unknown and undescribed from several individual areas.

The various forms and actual number of species recognized in each subgenus have been rather indefinite, since a good number of them are still difficult to identify because of superficial descriptions and sometimes also because they were studied within a limited area. The complexity of forms and species is evident in most subgenera which have been intensively studied, for instance: Mochthogenes (Delfinado 1966; Klein and Sirivanakarn 1969); Lophoceraomyia (Colless 1965; Bram and Rattanarithikul 1967); Culiciomyia (present studies); Culex (Colless 1957; Bram 1967; Lien 1968). There are many unsettled questions and differences of opinion about the identity and the specific status of forms or of various geographical populations in almost all subgenera. This situation, constantly apparent in the present work, seriously reflects many major gaps in the knowledge of Southeast Asia Culex.

Geographically, our present knowledge of the Culex fauna is largely limited to some countries, for example: Thailand (Bram 1967, whole genus); Malaysia (Colless 1957, some species groups in the subgenus Culex; 1965,

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Lophoceraomyia); and the Philippines (Delfinado, 1966, whole genus). There are several major areas in which the genus or in fact certain subgenera have been only superficially studied or not at all, as for instance: Indonesia (Bonne-Wepster and Brug 1937; Bonne-Wepster 1954; Brug 1931; 1932; Brug and Edwards 1931); southern parts of the Philippines and some islands in the Indian Ocean and South China seas, Burma and E. Pakistan. The distribution records of species within the whole or individual areas are very incomplete and in certain cases doubtful.

Although species and species groups are better known in some areas the descriptions of most species are still incomplete, particularly in the immature stages. I have found in the present study that the pupae which have been most frequently neglected may provide good and reliable characters. A serious problem often encountered in the identification of many forms relates to the female. This has been the most difficult stage to identify in Lophoceraomyia in which they are usually inseparable unless accompanied by associated pupal or larval skins or both from individual rearing. This difficulty also appears in other subgenera. In differentiating species in a complex, complete descriptions of all stages are very necessary for establishing identity, for analysis of individual variations and for deciding on specific status. At present, our information relative to local and geographical variations of most species is very incomplete and accordingly has led to taxonomic confusion in a number of cases. Among the difficult and confused situations currently encountered in the delimitation of species is the true or acceptable status of the various forms recognized in, for example: 1) the vishnui subgroup; 2) the mimeticus subgroup; and 3) the bitaeniorhynchus subgroup. These cases are briefly discussed below.

The vishnui subgroup is a complex of very similar species including vishnui, pseudovishnui, annulus, perplexus, alienus and tritaeniorhynchus. All are difficult to distinguish as adults but are strongly differentiated as larvae. All except vishnui were known in both adult and larval stages after Colless revised the group in 1957. Lately, Reuben (1968) redescribed vishnui and sunk annulus under this species on the basis of similarity in the larval stage. C. annulus was originally described from Hong Kong and is very widely distributed in Malaya, Thailand (Bram 1967) and the Philippines (Delfinado 1966). Present study confirms it is very similar to vishnui in the larval stage but the adults appear to differ constantly in the absence of pale speckling on femora and in color of scutal scales. Reuben's conclusion, however, needs further confirmation because of lack of information about the range and limit of variation in the adult stage. Lately, Lien (1968) described neovishnui from Taiwan, as distinct from pseudovishnui by a single feature in the larva. There is some doubt here as well, since there is little knowledge of variation among larvae of these species.

The mimeticus subgroup, originally established by Edwards (in Barraud 1934) to include 7 species: mimeticus, mimulus, mimuloides, fuscifurcatus, orientalis, jacksoni and diengensis was based particularly on the character of the pale spotting of the wings and the male terminalia. Later, Baisas (1938) added 3 forms: fasyi, confusus and suborientalis from the Philippines and Colless (1955) described propinquus from Malaya. Most recently, Lien (1968) described 4 more new species: neomimulus, murreli, kangi and tsengi from Taiwan, thus bringing the total up to 15 species in this subgroup. The validity of a number of these species has been found to be rather difficult to settle, since most of the older species, especially, mimeticus, mimulus, fuscifurcatus, jacksoni and diengensis are definitely known only as adults. The situation is further complicated by the fact that the immatures do not always provide a clue to the identity of the adult. For instance, C. kangi apparently shows male terminalia similar to that of fasyi, but its larva

resembles jacksoni and fuscifurcatus; the larva of fasyi is inseparable from that of mimeticus; etc. In the preliminary study, I also found it difficult to separate neomimulus from mimulus in both adult and larval stages, and murreli from mimulus and neomimulus in adult stages. The problems encountered here strongly indicate the need for more detailed study of all forms over a wider geographical area including also the type localities where they were originally found.

The bitaeniorhynchus subgroup. In Southeast Asia, there are 4 species recorded: bitaeniorhynchus, pseudosinensis, geminus and sinensis. Among these, bitaeniorhynchus is strongly polymorphic in the adult stage and 5 forms were distinguished by Edwards (1922). The variability of bitaeniorhynchus has never been analyzed in any revision and at present it can still be easily mistaken for pseudosinensis although both have been rather definitely characterized by Colless (1955) and Bram (1967). C. geminus from Malaya is rather similar to C. cornutus from India, but comparison between them was not mentioned in the literature (Colless 1955).

The problems discussed above are just a few and obviously reflect the incompleteness of studies in the past, most probably due to placing too much emphasis on one or on a few stages for description or limiting the study of a species to a restricted area.

Another basic and related concern in the present study is the systematic treatment of the subgenera and the genus as a whole. It appears that little attention has been paid to confirm and determine the affinity of species in almost all subgenera except some species groups in Culex (Culex). Few efforts have been made to group species within a subgenus although it is obvious that this could be very helpful, not only in the making of better keys but also in the analysis of the phylogeny of each subgenus. There is certainly little that can be done to improve Edwards' scheme of classification unless we have a more complete knowledge of species groups or complexes in each subgenus. To this, I like to add that the suggested supraspecific classification as developed by Bram (1969) based on both adults and larvae is still rather artificial in part. In fact, in considering Lutzia as a subgenus separated from the others, he based his conclusion on the larva alone while adults have a great deal in common with members of the subgenus Culex. Further, combining Mochthogenes with Neoculex, but not splitting certain distinct lineages within the subgenus, completely obscures the relationship between them and other species groups which were originally recognized by Edwards (1932).

The present study is essentially an attempt to revalidate species and revise the genus over a wider area of Southeast Asia than any other attempts in the past. It is hoped to completely settle many of the troublesome taxonomic problems as indicated, as well as to develop a better scheme of natural classification. In SEAMP's collections, specimens from some critical areas are still lacking or poorly represented, particularly from Borneo, Sumatra, Java, Celebes, Taiwan, Burma, W. Pakistan and adjacent islands.

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