CABIKEY Mosquito Genera of the World

Ralph Harbach and Graham Sandlant

Department of Entomology, The Natural History Museum, Cromwell Road, London SW7 5BD, UK

E-mail: r.harbach@nhm.ac.uk

The CABIKEY to mosquito genera of the world (Harbach & Sandlant, 1997) is supplied on CD-ROM (£195, ISBN 0 85199 170) and is designed to run under Windows 3 x or Windows 95 on a 486 PC with 8 MB RAM, and ideally displaying at least 256 colours. The key was developed to enable identification to genus level of all mosquitoes of the world. The target audience for this product includes vector control workers, entomologists and taxonomists, human health and disease researchers and anyone interested in the systematic and biological diversity of mosquitoes. The application includes separate keys for adults and larvae, and information on classification and distribution, characteristics, bionomics, medical and economic importance, and important references for each genus. Comprehensive help files contain information and illustrations on mosquito morphology, a glossary of anatomical terms, mosquito-borne diseases, infrasubfamilial taxa and references. In addition to being a complete reference work for mosquito biology and natural history, it is a training tool for non-professionals. A free demonstration CD-ROM containing a small sample set of data from this application is available on request from CABI's Publishing Division in Wallingford, UK (Tel: +44(0)I491 832111, Fax: +44(0)1491826090, E-mail: cabi@cabi.org).

This electronic publication might not have been prepared if we had known how much time it would eventually consume. What started out as a yearlong project lasted more than three years. As explained below, the research required to produce the CABIKEY illustrates that our knowledge of mosquito taxonomy is still very incomplete. The following paragraphs are modified from the introduction to the CABIKEY.

Identification keys are of fundamental importance in biology. Biological research depends upon the correct identification of organisms. In addition to being essential tools in systematic studies, keys are the starting point for obtaining information about a given taxon and are highly useful in biological studies of all types. This is especially true in the case of mosquitoes because of their importance as vectors of pathogens which cause human diseases. The need to correctly identify members of the family Culicidae dates back to the turn of the century when it was discovered that malaria and yellow fever were transmitted by mosquitoes.

The most recent and comprehensive keys to the mosquito genera of the world were developed by Mattingly (1971). These keys have been variously modified and adapted over the years by different authors, but their basic construct and design have changed little despite improved knowledge of mosquito morphology and diversity, and the advent of personal computers. Since 1971 the number of formally recognised genera has risen, previously unknown life stages and species have increased the morphological diversity of the genera, and interactive computer identification systems have been developed, thus dictating the need for thoroughly revised and modernised keys for recognising the mosquito genera.

CABIKEY for the mosquito genera of the world started out as an experiment to determine how easy or difficult it would be to develop an interactive computer key from information contained in traditional keys. Unlike conventional dichotomous keys, essentially every character used in the computer key must be scored in a data matrix for every taxon to be identified. Initially we tried to develop a data matrix by extracting character information contained in the keys of Mattingly (1971). It was apparent early on that approximately 60% of the character data needed to complete the matrix was unavailable in Mattingly's key. Once the usable data had been extracted and incorporated into the matrix, it was then necessary to search through hundreds of published works for missing data. But much of the missing data could not be found in the mosquito literature and it became necessary to make extensive use of the mosquito collection at the

Natural History Museum, London, to verify and obtain missing character data from available species of most genera. This work also led to the discovery of some new characters that were subsequently included in the keys. We believe that these efforts have resulted in the development of the most highly effective keys ever constructed for the recognition of the mosquito genera of the world.

As the project progressed, a not-so subtle change began to be apparent in the completed parts. An increased effort was made to replace or complement drawings in the adult key with scanning electron micrographs and introduce a number of three-dimensional video-microscope images into various parts of the application. These efforts in turn made it necessary to restructure all questions and associated displays. Also, as the keys were being upgraded, the associated text and glossary were being developed with a greater amount of detail and sophistication than originally planned. The addition of these refinements considerably enhanced the quality and effectiveness of the final product.

The keys will appear unorthodox to individuals who are only familiar with verbal or pictorial dichotomous keys and the morphological features traditionally used to distinguish mosquito genera. It is important to keep in mind that interactive keys operate by progressively excluding **all** taxa from consideration which do not share a particular character with the taxon being identified. This means that it takes fewer steps to reach an identification than it does with ordinary dichotomous keys, hence some conventional characters will not be seen during the identification process which are normally encountered in traditional keys. A number of unconventional and new characters are likely to be encountered during the identification of many specimens.

The taxonomy of mosquitoes is far from complete and the currently accepted system of classification is not entirely natural. Indeed, one of the major handicaps in preparing the keys was the obvious polyphyletic nature of some of the larger taxa. REH is aware of at least one new genus included within the genus *Wyeomyia*, the need to elevate certain subgenera within the tribe Sabethini to generic status, and numerous taxonomic problems involving most levels of classification. Because the current system of classification is problematic, the development of keys to the genera as they are currently recognised was not an easy task. However, we designed the keys so that all of the exceptional species and taxa that we are aware of will key out to the genus in which they are currently assigned. Obviously we could not make allowances for any exceptions that are likely to exist in undiscovered species and unknown life stages. Therefore we ask users to notify us of any difficulties that they encounter while identifying the adult and larval stages of any species to generic level with these keys. We invite all comments, constructive or otherwise, which will help us to improve future editions of the product.

The family Culicidae is divided into three subfamilies: Anophelinae, Culicinae, and Toxorhynchitinae. The Anophelinae includes three genera, the Toxorhynchitinae includes a single genus, and the subfamily Culicinae 34 genera. The subfamily Culicinae is further divided into 10 tribes. This is the classification currently followed in *A Catalog of the Mosquitoes of the World* (Knight & Stone, 1977) and its three supplements (Knight, 1978; Ward, 1984, 1992; Gaffigan & Ward, 1985). Five categories of information are provided for each genus, as well as the family, the three subfamilies, and the two largest tribes of the subfamily Culicinae, the Aedini and the Sabethini. Information is provided for the two tribes because the limits of the included genera are not clearly defined and problems are often encountered in distinguishing them. The five categories of information include CLASSIFICATION AND DISTRIBUTION, CHARACTERISTICS, BIONOMICS, MEDICAL AND ECONOMIC IMPORTANCE, and IMPORTANT REFERENCES. Once an identification is reached, users are encouraged to consult the appropriate descriptive treatments to obtain further information and insights into the nature of the genus and the higher levels of classification to which it belongs. The CABIKEY also includes an interactive file on mosquito morphology and an extensive glossary of anatomical and other useful terms. The glossary includes all of the anatomical terms used in the keys and the file on mosquito morphology.

The CABIKEY contains two different key methods, 'Standard' and 'Advanced'. When using the **Standard key**, users are presented with questions in a sequence determined partly from a list of priority characters,

and partly calculated by CABIKEY from the data structure. The **Advanced key** allows users to answer questions which they choose from a 'list of good characters'. We recommend use of the **Standard key** with **Parent Characters** on the **Options menu** set to **Never assume any answers**. With this setting, all relevant questions will be presented, even those that do not have any separation power, and where only one character state fits all remaining taxa. This could be useful in cases where the user unknowingly has a new species or life stage with unique characters which we were unaware of when the key was developed. Answering these additional questions will give early indication of an error, and guarantee the correct identification of all currently known species to the appropriate genus. Users are advised to select **Check Identification** to verify all identifications. Further verification can be achieved by examining **Diagnosis** and **Description** from the **Details** menu, as well as the CHARACTERISTICS provided for the genus (see also the CABIKEY Help file). If, however, after careful comparison the identification is uncertain or doubtful, then it is advisable to seek the assistance of a professional taxonomist.

Thirty-eight mosquito genera are currently recognised by mosquito taxonomists. This number will increase as more systematics research and new tools and cladistic analyses are used to develop a more natural classification, and this data will serve as a basis for constructing future keys. But at this moment, users should rest assured that the interactive keys of this CABIKEY product offer the most effective means of accurately identifying the mosquito genera that are currently recognised.

References

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