MOS-KEY-TOS®: an interactive key for the identification of the immature stages of Italian mosquitoes

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The software MOS-KEY-TOS® is a computer-based expert system developed with the aim of providing the Italian National Health Agencies, involved in public environmental prevention and hygiene, with a tool for the identification of Italian mosquitoes. MOS-KEY-TOS is a set of data and graphics files written in the DELTA (DEscription Language for TAxonomy) format for use with the program INTKEY, an interactive program for identifying a specimen by comparing its attributes with stored descriptions of taxa.

MOS-KEY-TOS☐ is useful for beginners for quick and correct identification and it familiarises the user with all of the required morphological characters. It has proven to be an excellent training tool for entomologists and public health workers. The knowledge base can be expanded and refined, and an extension to include all of the mosquitoes of Europe is already planned.

Program description

The package MOS-KEY-TOS® contains an interactive key for identification of the eggs, pupae and fourth-instar larvae of the genera, and the fourth-instar larvae of the individual species of the Italian Culicidae. However, some species that are morphologically very similar can only be identified to group level. There are 67 larval characters, but only about 15 are necessary to identify any given specimen. The user can also identify genera using a maximum of 7 characters for eggs and 12 for pupae. Using a microscope, the user enters his/her observations of the specimens as prompted by a computer menu. Characters are displayed in order of their effectiveness at the current stage of the identification, but the user can scan the character menu and select the most suitable or available character. Morphological characters are fully illustrated in colour and can be selected by clicking with the mouse.

Additionally, a complete description of the different taxa can be obtained, and through a menu-board, the general morphology, biology and health importance of Italian Culicidae can be displayed. Notes on the biology and distribution are given for all taxa and a bibliography is provided, with a complete list of references published since 1960, as well as selected references published before that date.

The 63 species of mosquitoes belonging to the Italian fauna are considered. They are:

Anopheles algeriensis Theobald, 1903; *An. atroparvus* Van Thiel, 1927; *An. claviger* (Meigen, 1804); *An. hispaniola* (Theobald, 1903); *An. hyrcanus* (Pallas, 1771); *An. labranchiae* Falleroni, 1926; *An. maculipennis* Meigen, 1818; *An. marteri* Sevenet and Prunelle, 1927; *An. melanoon* Hackett, 1934; *An. messeae* Falleroni, 1926; *An. petragnani* Del Vecchio, 1939; *An. plumbeus* Stephens, 1828; *An. sacharovi* Favre, 1903; *An. sergentii* (Theobald, 1907); *An. subalpinus* Hackett and Lewis, 1935; and *An. superpictus* Grassi, 1899;

Aedes aegypti (Linnaeus, 1762); *Ae. albopictus* (Skuse, 1897); *Ae. annulipes* (Meigen, 1830); *Ae. berlandi* Seguy, 1821; *Ae. cantans* (Meigen, 1818); *Ae. caspius* (Pallas, 1771); *Ae. cataphylla* Dyar, 1916; *Ae .cinereus* Meigen, 1818; *Ae. communis* (De Geer, 1776); *Ae. detritus* Haliday (1833); *Ae. dorsalis* (Meigen, 1830); *Ae. echinus* (Edwards, 1930); *Ae. geminus* Peus, 1970; *Ae. geniculatus* (Olivier, 1791); *Ae. mariae* Sergent and Sergent, 1903; *Ae. pulcritarsis* (Rondani, 1872); *Ae. pullatus* (Coquillet, 1904)*; Ae. punctor* (Kirby, 1837); *Ae. refiki* Medschid, 1928; *Ae. rusticus* (Rossi, 1790); *Ae. sticticus* (Meigen, 1838); *Ae.*

surcoufi (Theobald, 1912); *Ae. vexans* (Meigen, 1830); *Ae. vittatus* (Bigot, 1861) and *Ae. zammitii* (Theobald, 1903);

Coquillettidia buxtoni (Edwards, 1923) and *Cq. richiardii* (Ficalbi, 1889);

Culex brumpti Gailliard, 1931; *Cx. hortensis* Ficalbi, 1889; *Cx. impudicus* Ficalbi, 1890; *Cx. laticinctus* Edwards, 1913; *Cx. martinii* Medschid, 1930; *Cx. mimeticus* Noé, 1899; *Cx. modestus* Ficalbi, 1889; *Cx. univittatus* Theobald, 1901; *Cx. pipiens* Linnaeus, 1758; *Cx. territans* Walker, 1856; *Cx. theileri* Theobald, 1903; and *Cx. torrentium* Martini 1925;

Culiseta annulata (Schrank, 1776); *Cs. fumipennis* (Stephens, 1825); *Cs. litorea* (Shute, 1928); *Cs. longiareolata* (Macquart, 1838); *Cs. morsitans* (Theobald, 1901) and *Cs. subochrea* (Edwards, 1921);

Orthopodomyia pulcripalpis (Rondani, 1872);

Uranotaenia unguiculata (Edwards, 1913).

System requirements

The program will run on any computer with Microsoft Windows version 3.1 or 95. We have used it successfully on 386 and 486 notebook and desktop machines, as well as a Power Macintosh 6100/60 AV and a 7100/66 AV running SoftWindows version 1.0 (a Microsoft Windows 3.1 emulator). MOS-KEY-TOS requires 15 MB of hard disk space.

Distribution format

INTKEY and MOS-KEY-TOS are distributed via anonymous FTP at the following address: ftp://www.iss.it/culicidi. The files delta.use and delta.reg contain information on registration and conditions of use for INTKEY□ and must be read before using the program. The other files contain the data and graphics files on ARJ format for MOS-KEY-TOS . The archive also contains a directory structure that will be automatically created on the hard disk when the file is installed.

Conditions of use

The data and graphics files of MOS-KEY-TOS® are designed for use with the program INTKEY® . These files are provided free of charge. They may be copied and redistributed without restriction. The INTKEY□ program is copyrighted by the CSIRO Division of Entomology (GPO Box 1700, Canberra ACT 2601, Australia) and is provided under the conditions of use' specified by the authors of those programs. Registration of INTKEY is necessary after a trial period of one month. Details can be found in the files delta.use and delta.reg accompanying the software.

Acknowledgements

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