European Mosquito Bulletin, 3 (1999), 1-11.
Journal of the European Mosquito Control Association
ISSN1460-6127

Identification keys of the mosquitoes (Diptera: Culicidae) of Continental Portugal, Açores and Madeira

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Introduction

An annotated checklist of the mosquitoes of Continental Portugal was published by Ribeiro *et al.* (1988), recording 40 species and subspecies belonging to 7 genera.

In the present paper *Aedes eatoni* (Edwards) and *Culex hortensis maderensis* Mattingly, endemic to the Madeira Islands, and *Culiseta atlantica* (Edwards), endemic to the Açores Archipelago (Azores) are included, so that the keys are valid both for the Continent and the Islands. Although *Ae. aegypti* (L.) has not been found in Portugal since 1956, and *Ae. albopictus* (Skuse) has not been recorded from Portugal, these species are included in the keys because of their potential presence.

A total of 45 species and subspecies, arranged in 15 subgenera and 7 genera are included in the adult and larval keys. In addition, keys to the larvae and pupae of the *Anopheles claviger* (Meigen) complex and to the eggs of the *An. maculipennis* Meigen complex known to occur in Portugal are also given. From our experience, the egg is the only stage that exhibits reliable morphological characters for the separation of these sibling species.

In the *An. maculipennis* complex, *An. subalpinus* Hackett & Lewis is treated as a valid species, according to Ramos *et al.* (1982) and as acknowledged in the last supplement of the *Catalog of the mosquitoes of the World* (Ward, 1992). Allozyme electrophoresis studies of the Portuguese members of the complex are being carried out. *An. cinereus* Theobald is considered to be a polytypic species, with the Afrotropical nominal subspecies and the Mediterranean *hispaniola* (described by Theobald from Spain and the Canary Islands), as proposed by Ribeiro *et al.* (1980b) and acknowledged by Ward (1992). In the authors' opinion, the recent claim by Ramsdale (1998) that *hispaniola* should be treated as a junior synonym of *cinereus* appears not to be supported by the available evidence. Also, in contrast to Glick (1992), *An. marteri* Senevet & Prunnelle is treated as a monotypic species, in accordance with Ribeiro *et al.* (1985) and Ward (1992), the observed polymorphism being better explained as clinal (Ribeiro *et al.*, 1980b).

Concerning *Ae. vittatus* (Bigot), it is worth noting, somewhat unexpectedly, that no consistent morphological differences could be found between Portuguese and African populations of this species (Ribeiro *et al.*, 1977-78).

The distinction between *Ae. echinus* (Edwards) and *Ae. geniculatus* (Olivier) is also a delicate matter, although the scaling of the scutellum, in both sexes, and a few characters in the male genitalia and larvae are reliably diagnostic (Ramos, 1983-84).

As for *Ae. caspius* (Pallas), following the description of the subspecies *meirai* from the Cape Verde Archipelago (Ribeiro *et al.*, 1980a; Gaffigan & Ward, 1985), the form occurring in Portugal has been treated as the nominal subspecies, *An. caspius caspius*. In the absence of further studies, this is the status recognised for *caspius* in Portugal. The *Ae. detritus* (Haliday) complex is keyed out simply as the nominal species, though the sibling species "A" and "B" are already identified in Portugal (Capela, 1986). As expected, *Ae. mariae*, is the only recorded member of the *Ae. mariae* complex (Coluzzi & Sabatini, 1968; Knight, 1978). The *Ae. punctor* (Kirby) complex is represented in Portugal by an apparently relict population of the nominal species, restricted to the highest mountain, at over 1500m (Ribeiro *et al.*, 1983).

It is generally considered that *Cx. pipiens* L. and *Cx. molestus* Forskål are the same species. However they are treated separately in this paper as there is some evidence that they are distinguishable by biological characters in the female and morphological characters in the male genitalia and larva (Janz *et al.*, 1983). As in the case of *Ae. vittatus*, no significant differences were found between Portuguese and African populations of *Cx. univittatus* Theobald (Ribeiro *et al.*, 1977-78). Larvae of *Cx. impudicus* Ficalbi are not always distinguishable with certainty from those of *Cx. territans* Walker (Ramos *et al.*, 1977-78), although the key presented here will separate correctly almost all specimens.

Culiseta subochrea (Edwards) is treated as a valid species, as proposed by Ribeiro *et al.* (1977) and acknowledged by Ward (1984). Adults, both females and males, are very similar to those of *Cs. annulata*

(Schrank) in the external morphology but easily separable from *Cs. atlantica* (Edwards). Larvae of these three species are also very similar, though they can be separated with the keys given by Ramos & Ribeiro (1980), here adapted.

The present keys are based on the study of the mosquito collection of the Unidade de Entomologia Médica, Instituto de Higiene e Medicina Tropical, Lisboa, with more than 20 000 Portuguese specimens collected all over the country. The following works were particularly important references during the elaboration of the keys: Edwards (1921), Marshall (1938), Aitken (1954), Senevet & Andarelli (1956; 1959), Rioux (1958), Hedeen (1958; 1959), Gutsevich *et al.* (1974), Encinas Grandes (1982), Harbach (1985; 1988), Cranston *et al.* (1987), Snow (1990), Glick (1992), Schaffner (1992; 1993), Stojanovich & Scott (1995), Dahl (1997), Darsie & Samanidou-Voyadioglou (1997) and Romi *et al.* (1997).

The general taxonomic treatment adopted is that of Knight & Stone (1977), while the morphological terminology follows Harbach & Knight (1980; 1981).

Key to adults to subfamilies and genera

As only one species of each of the genera *Coquillettidia, Orthopodomyia* and *Uranotaenia* are known from the study area, those species are keyed out with the corresponding genera.

1 Scutellum evenly rounded, with setae evenly distributed along border; abdominal sterna (and usually also terga) wholly or largely devoid of scales; maxillary palp about as long as proboscis in both sexes (somewhat spatulate, at apex, in the male) (subfamily *Anophelinae*)..... *Anopheles*

— Scutellum trilobed, with setae in three distinct groups; both abdominal sterna and terga covered with scales; female palps distinctly shorter than proboscis; male palps longer than proboscis (subfamily *Culicinae*).....2

2 Calypter bare; anal vein reaching wing margin at about level of base of the fork of cubitus; wing membrane apparently without microtrichia, these being visible only under high magnifications ..... *Uranotaenia unguiculata unguiculata*

— Calypter fringed; anal vein reaching wing margin well beyond base of the fork of cubitus; wing microtrichia visible under low magnifications.....3

3 Prespiracular setae present..... *Culiseta*

— Without prespiracular setae.....4

4 Paratergite with scales; ungues of foreleg toothed..... *Aedes*

— Without scales on paratergite; ungues of foreleg simple.....5

5 Pulvilli present; without postspiracular setae..... *Culex*

— Pulvilli absent or rudimentary; with or without postspiracular setae.....6

6 First tarsomere of foreleg longer than distal four tarsomeres together; fourth tarsomere of foreleg shorter than fifth..... *Orthopodomyia pulcripalpis*

— First tarsomere of foreleg not longer than distal four tarsomeres together; fourth tarsomere of foreleg not shorter than fifth..... *Coquillettidia richiardii*

Key to subgenera, species and subspecies of *Anopheles* adults

1 Costal vein with, at least, four pale spots (subgenus *Cellia*)..... *An. cinereus hispaniola*

— Costal vein all dark, without pale spots (subgenus *Anopheles*).....2

2 Wing with patches of dark scales at the crossveins.....*An. maculipennis* complex
(See also key to eggs of the *An. maculipennis* complex)

— Without dark patches at the crossveins.....3

3 Wing with a yellow spot at apical fringe of wing.....*An. marteri*

— Without yellow spot at apical fringe of wing.....4

4 Head without a pale frontal tuft.....*An. algeriensis*

— With a white frontal tuft projecting forward between the eyes.....5

5 Medio-cubital crossvein distant from the radio-medial crossvein for less than its own length; medium-sized, ground-breeding mosquitoes; male 5th palpomere less than half of 4th.....*An. claviger* complex
(See also pupal and larval keys to the sibling species of the *An. claviger* complex)

— Medio-cubital crossvein distant from the radio-medial for about its own length; small tree-hole breeding mosquitoes; male 5th palpomere at least as long as 4th.....*An. plumbeus*

Key to eggs of the *Anopheles maculipennis* complex

1 Float ridges finely corrugated; upper surface with two black bars near the ends of the floats, sharply contrasted with uniformly light ground.....*An. maculipennis s.s.*

— Float ridges smooth; upper surface either all dark or with a different pattern 2

2 Upper surface uniformly dark, without pattern.....*An. melanoon*

— Upper surface with a pattern of irregular black patches, with or without transverse bars 3

3 With a pattern of two transverse bars near the ends of the floats, and a few irregular black patches in the area between the bars; float index about 0.40 or greater .....*An. subalpinus*

— Pattern not formed into definite transverse bars, but consisting mainly of irregular triangular black spots arising from margins, on a lighter ground; float index 0.34-0.36.....*An. atroparvus*

Key to pupae of the *Anopheles claviger* complex

1 Spine-like seta 9-IV of fourth abdominal segment weakly sclerotized, similar to that of segment II .....*An. claviger*

— Spine-like seta 9-IV heavily sclerotized, similar to that of segment V.....*An. petragnani*

Key to subgenera, species and subspecies of *Aedes* adults

1 Female proboscis longer than fore femur; male claspettes present, with a stem and a distal curved filament; aedeagus an unpaired simple structure 2

— Female proboscis only about as long as fore femur; male without claspettes; aedeagus a paired, more complicated structure 11

2 Without lower mesepimeral setae; hind ungues simple; male gonocoxite without basal lobes (subgenus *Finlaya*).....3

— With several mesepimeral setae; hind ungues toothed; male gonocoxite with a distinct basal lobe (subgenus *Ochlerotatus*).....5

3 Pale thoracic lines golden-yellow; male maxillary palp about 0.66 as long as proboscis (Madeira Islands).....*Ae. eatoni*

— Pale thoracic lines creamy-white; male maxillary palp longer, only slightly shorter than proboscis.....4

4 Scales of scutellum all broad, flat and white; stem of claspette in male about as long as filament, with numerous scattered small setae; claspette filament slightly curved .....*Ae. echinus*

— Scutellum with at least a few narrow ochraceous scales, usually more numerous on lateral lobes; stem of claspette in male much longer than filament, with small setae arising from a tubercule; claspette filament strongly curved.....*Ae. geniculatus*

5 Hind tarsomeres 1-5 with pale rings.....6

— Hind tarsomeres not ringed.....9

6 Abdominal pale bands broader in middle, usually forming a median dorsal stripe which may reach the distal margin of segments.....7

— Abdominal terga with pale bands at base of the segments only, not broadened in middle.....8

7 Mesonotum with two submedian stripes of creamy-white scales.....*Ae. caspius caspius*

— Mesonotum without stripes, covered mainly by yellow-brown scales intermingled with whitish scales .....*Ae. mariae*

8 Mesonotum with dark-brown and pale markings, the latter sometimes much reduced .....*Ae. berlandi*

— Mesonotum all yellowish, without dark brown markings.....*Ae. pulcritarsis pulcritarsis*

9 Proepimeral scales all flat and very broad .....*Ae. rusticus rusticus*

— Upper proepimeral scales, at least, narrow and curved 10

10 With a patch of scales on the postprocoxal membrane behind the base of fore coxa; fore and mid femora with only a few pale scales in front; male aedeagus minutely denticulate distally.....*Ae. punctor*

— Without scales on postprocoxal membrane; fore and mid femora conspicuously mottled in front, with dark and pale scales; male aedeagus smooth.....*Ae. detritus*

11 Scutum with more or less evident median or submedian lines of white scales, with or without other white markings; male gonocoxite with well developed basal lobe; gonostylar claw at tip of gonostylus (subgenus *Stegomyia*).....12

— Scutum either without white markings or with small paired lateral white dots; male gonocoxite without basal or apical lobes; gonostylar claw placed well before tip (subgenus *Aedimorphus*).....13

12 Scutum with lyre-shaped pattern of silvery white scales; mid femora with a median line of white scales from base to near apex, in front; female clypeus with a distinct patch of silvery-white scales .....*Ae. aegypti*

— Scutum with only a silvery white median stripe; mid femora dark in front; female clypeus bare.....*Ae. albopictus*

13 Scutum with three pairs of small white dots; scales of scutellum flat and broad; with lower mesepimeral setae; fifth tarsomere of hind leg entirely white ..... *Ae. vittatus*

— Scutum without white dots; scutellum with narrow, curved scales; without lower mesepimerals; fifth tarsomere of hind tarsus with only a small white basal ring ..... *Ae. vexans vexans*

Adult key to subgenera, species and subspecies of *Culex*

1 Proboscis shorter than fore femur; first tarsomere of hind tarsus (Ta1 III) markedly shorter than hind tibia, ratio Ta1 III /hind tibia ≤0.85 (subgenus *Barraudius*)..... *Cx. modestus modestus*

— Proboscis about as long or longer than fore femur; Ta1III /hindtibia ≥0.86, usually greater 2

2 Abdominal terga III-VII with apical pale markings 3

— Abdominal terga III-VII with basal pale markings, though some pale scaling may be present on apical borders (subgenus *Culex*).....6

3 Prealar and postspiracular scales present (subgenus *Maillotia*).....4

— Without prealar and postspiracular scales (subgenus *Neoculex*) 5

4 Abdominal terga III-VII with complete pale bands, broadening in middle; sterna III-VII mainly pale, with quite distinct basolateral dark triangles which may join at the base of the segment; femora and tibiae of mid and hind legs with conspicuous pale spots at their apices..... *Cx. hortensis hortensis*

— Terga III-VII dark above, with only small apicolateral pale spots; sterna III-VII mainly dark, with narrow apical pale bands which may be somewhat expanded in middle; apical pale spots of femora and tibiae either absent or inconspicuous (Madeira Islands) ..... *Cx. hortensis maderensis*

5 Pale bands on abdominal terga always broader at the sides, sometimes interrupted in middle; last abdominal segments of male with numerous, long setae..... *Cx. impudicus*

— Pale bands on terga not broadened at sides, sometimes represented only by a line of pale scales along distal border of the segment; last abdominal segments of male not unusually setose..... *Cx. territans*

6 Wings with 3 conspicuous pale areas on the costa and other pale markings on other veins ..... *Cx. mimeticus*

— Wings without such pale areas 7

7 All tibiae with anterior pale stripes ..... *Cx. theileri*

— Fore tibiae, at least, unstriped.....8

8 With 2-4 lower mesepimeral setae; abdominal terga with very broad pale bands not reduced toward sides, that on tergum II occupying half or more of the segment ..... *Cx. laticinctus*

— Usually, with only one mesepimeral seta; pale bands of abdominal terga narrower, often reduced at sides and even absent on some segments 9

9 With a small patch of pale scales at extreme base of costa, dorsally; usually at least a few postspiracular scales present; prealar scales always present ..... *Cx. univittatus*

— Costa all dark; without postpiracular scales; prealar scales present or absent 10

10 Cell R2 more than 4.0 times the length of vein R2+3; in male both ventral and dorsal divisions of aedeagus bent; seta *h* on apical lobe of gonocoxite narrow, striated and foliform ..... *Cx. torrentium*

— Cell R2 less than 4.0 times the length of vein R2+3; in male only ventral division of aedeagus bent, sickle-shaped; seta not foliform.....11

11 In male, sclerotized ridge of lateral arm (of external division) of the aedeagus running along the bottom of the groove; lobes of tergum IX with 8-16 setae each side (mean, 11.7); female stenogamic, autogenic and homodynamic.....*Cx. molestus*

— In male, sclerotized ridge of lateral arm of the aedeagus placed on ventral wall of the groove; lobes of tergum IX with 5-13 setae each (mean, 8.5); female eurygamic, anautogenic and heterodynamic .....*Cx. pipiens*

Adult key to subgenera and species of *Culiseta*

1 Thorax with sharply defined white stripes; tibiae with white stripes; male palps about 0.67 to 0.75 as long as proboscis (subgenus *Allotheobaldia*).....*Cs. longiareolata*

— Thorax without sharply defined white stripes; tibia lacking white stripes; male palps at least as long as proboscis.....2

2 Cross-vein *mcu* approximated to, usually in line with, *rm* (subgenus *Culiseta*).....3

— Cross-vein *mcu* well not aligned with *rm* (subgenus *Culicella*).....5

3 Without a longitudinal pale band on tergum II; first tarsomere of hind tarsus not ringed (Açores Archipelago).....*Cs. atlantica*

— With a longitudinal pale band on tergum II; first tarsomere of hind tarsus with a pale ring at middle (Continent).....4

4 Wing vein Cu usually entirely dark-scaled (occasionally, with a few pale scales); abdominal terga with pale (largely white) scales often restricted to basal bands and longitudinal band on tergum II; dark wing spots distinct.....*Cs. annulata*

— Some pale scaling always present on vein Cu; abdominal terga with yellowish scales scattered over dark areas; wing spots less distinct .....*Cs. subochrea*

5 Tarsi with conspicuous pale rings at all joints; male palps surpassing tip of proboscis by at least half length of last palpomere; 3rd and 4th palpomeres densely setose; basal lobe of gonocoxite with 3 or 4 stout setae, none of them reaching to apex of gonocoxite.....*Cs. fumipennis*

— Tarsal rings less distinct on last two joints of fore and mid legs and inconspicuous or absent on hind legs; male palps and proboscis subequal in length; 3rd and 4th palpomeres with only a few setae; basal lobe of gonocoxite with 2 stout setae, one of which reaches at least to tip of gonocoxite .....*Cs. litorea*

Key to subfamilies, genera, subgenera, species and subspecies of larvae

1 Without respiratory siphon; palmate setae more or less developed on some abdominal segments (subfamily *Anophelinae*, genus *Anopheles*) 2

— Respiratory siphon present; without palmate setae (subfamily *Culicinae*) 8

2 Inner clypeal setae (2-C) widely separated, about as far apart as from the outer clypeal (3-C); at least one of the long metapleural setae feathered (subgenus *Cellia*).....*An. cinereus hispaniola*

— Inner clypeals approximate, much closer to one another than to the outer clypeal; both long metapleural setae simple or, at most, with 2 or 3 branches (subgenus *Anopheles*) 3

3 Antenna smooth; subantennal seta (11-C) very short, with only 2 or 3 branches; frontal setae 5, 6 - and 7-C simple ..... *An. plumbeus*

— Antenna spiculate; seta 11-C nearly as long as antenna, with at least 18 branches; setae 5 -, 6- and 7-C branched 4

4 Outer clypeal seta dentritic, fanlike..... *An. maculipennis* complex (See key to eggs)

— Outer clypeal seta simple or very slightly branched 5

5 Leaflets of abdominal palmate setae abruptly narrowed before apex..... *An. marteri*

— Leaflets of abdominal palmate setae uniformly tapering to apex 6

6 Seta 2-C frayed, with short lateral branches; dorsal plate of abdominal segment VIII slightly larger than distance between palmate setae; seta 0 on abdominal segments IV and V unusually developed, with 4-7 branches; saddle seta (1-X) inserted well within margin of saddle; head capsule with dark transversal bands ..... *An. algeriensis*

— Setae 2-C simple or bifurcate distally; distance between palmate setae on segment VIII greater than plate; setae 0-IV and 0-V minute, simple or bifid; saddle seta 1-X inserted at the edge or just outside saddle; dark markings of head capsule forming a dotted pattern (*An. claviger* complex; see also keys to pupae)..... 7

7 Ante-palmate setae of segments IV and V (2-IV,V) usually with 4 (3-5) branches of about the same length..... *An. claviger*

— Setae 2-IV, V bifid or with 3 branches, the middle one shorter than the others ..... *An. petragnani*

8 Abdominal segment VIII with lateral or dorsolateral plates..... 9

— Without plates on the abdominal segments..... 10

9 Dorsolateral plates present on both abdominal segments VII and VIII; siphon without pecten (genus *Orthopodomyia*)..... *Or. pulcripalpis*

— Abdominal segment VII without plates; siphon with pecten (genus *Uranotaenia*, subgenus *Pseudoficalbia*)..... *Ur. unguiculata unguiculata*

10 Siphon attenuated, with saw, adapted for piercing plant tissues (genus *Coquillettidia)* ..... *Cq. richiardii*

— Apex of siphon blunt, without saw, not adapted for piercing..... 11

11 Siphon with only one pair of subventral setae or tufts (setae 1-S) 12

— Siphon with 3 or more pairs of subventral setae or tufts (1-S) (genus *Culex*) 31

12 Siphonal setae inserted near base (genus *Culiseta)* 13

— Subventral seta of siphon inserted away from base, at about 0.33 or beyond (genus *Aedes*) 18

13 Distal pecten spines long and hair-like (subgenus *Culiseta*) 14

— Pecten spines all stout, without modified hair-like elements 16

14 Distance between head-setae 4-C obviously greater than distance between setae 5-C (Açores Archipelago) ..... *Cs. atlantica*

— Distance between setae 4-C about the same as distance between setae 5-C, or less (Continent)..... 15

15 Siphon tuft (1-S) about as long as siphon breadth at base ..... *Cs. annulata*

— Tuft 1-S obviously shorter than breadth of siphon at base..... *Cs. subochrea*

16 Saddle incomplete; pecten with 6-12 widely spaced spines beyond tuft, extending to about 0.75 of siphon; siphonal index less than 2.5 (subgenus *Allotheobaldia*)..... *Cs. longiareolata*

— Saddle complete; pecten otherwise; siphonal index 3.5 or greater (subgenus *Culicella*) 17

17 Pecten with 2-4 isolated larger spines reaching to about 0.5 of siphon; subapical seta of siphon (2-S) well developed and branched..... *Cs. fumipennis*

— Pecten without isolated spines distally, restricted to basal 0.33 of siphon; seta 2-S of siphon inconspicuous and simple..... *Cs. litorea*

18 Antennal seta (1-A) simple, occasionally bifid; antenna smooth..... 19

— Seta 1-A double or multiple; antenna spiculate, even if only sparsely so..... 23

19 Siphon without acus; head setae 4-, 6-C inserted far forward (subgenus *Stegomyia*) 20

— Siphon with acus; head setae 4-, 6-C more posterior (subgenus *Ficalbia*) 21

20 Spine at base of the metapleural group of setae 10-12-MT strongly sclerotized, curved and pointed, thorn-like; comb scales with well developed basal denticles each side of central tooth ..... *Ae. aegypti*

— Base of setae 10-12-MT with only small denticles; comb scales with a strong central tooth and several delicate basal denticles..... *Ae. albopictus*

21 Comb of abdominal segment VIII consisting of a large patch of fringed scales (Madeira Archipelago)..... *Ae. eatoni*

— Comb made of one or two irregular rows of scales (Continent)..... 22

22 Pecten extending beyond middle of siphon; stellate setae of abdominal segment I obviously longer than the segment, some of them with 5-10 branches..... *Ae. echinus*

— Pecten not extending beyond middle of siphon; stellate setae on abdominal segment I about as long as segment, at most 6-branched..... *Ae. geniculatus*

23 Antennal seta 1-A with 2-3 branches; antenna sparsely spiculate, usually, not uniformly so 24

— Seta 1-A with more than 3 branches, usually much more; antenna more or less uniformly spiculate..... 26

24 Siphonal index about 2 or less; some of the most distal pecten teeth, at least, more widely spaced; siphon tuft (seta 1-S) inserted before the most distal pecten teeth..... *Ae. vittatus*

— Siphonal index about 4 or more; only the most distal pecten tooth more widely spaced; 1-S inserted beyond the pecten (*Ae. pulcritarsis* complex)..... 25

25 1-S at about 0.5 of siphon; comb with 9 (6-11) teeth in a single row; siphonal index always under 5 ..... *Ae. pulcritarsis pulcritarsis*

— 1-S at about 0.33; comb teeth usually more numerous, often arranged in an irregular triangular patch; siphonal index from about 3.5 to 7.5..... *Ae. berlandi*

26 One or more distal pecten spines more widely spaced.....27

— More distal pecten spines not obviously wider spaced.....29

27 Siphon with 3 or 4 pairs of simple setae on dorsal aspect.....*Ae. rusticus rusticus*

— Siphon with only 1 pair of such setae.....28

28 Comb on segment VIII with 18-28 scales, arranged in a triangular patch.....*Ae. caspius caspius*

— Comb with 9-12 scales, in irregular single or double row .....*Ae. vexans vexans*

29 Saddle complete.....*Ae. punctor*

— Saddle incomplete.....30

30 All comb scales consisting of spines, with a single median tooth much longer than submedian denticles .....*Ae. mariae*

— Comb mainly of scales with subequal denticles.....*Ae. detritus*

31 Comb of abdominal segment VIII made of spines, with a median tooth much longer than basal denticle...32

— Comb composed of fringed scales.....33

32 Antenna with subapical setae (2-, 3-A) arising at 0.33-0.5 the distance between apical setae and antennal shaft seta (1-A).....*Cx. mimeticus*

— Subapical setae 2-,3–A arising adjacent to apical setae of antenna.....*Cx. theileri*

33 Apicodorsal seta of siphon (2-S) large and hooked (subgenus *Maillotia*).....34

— Seta 2-S small and straight, not hooked.....35

34 Siphon with, at most, 11 or 12 subventral tufts; maximum ratio between length of tufts and diameter of siphon at point of attachment about 3 or less (Continent).....*Cx. hortensis hortensis*

— Siphon with 15 or more subventral tufts; such maximum ratio about 4-5.5 (Madeira Islands).....*Cx. hortensis maderensis*

35 Head setae 5- and 6-C with 5 or 6 and 4 branches, respectively; subventral tufts of siphon either simple or with 2-4 branches (subgenus *Culex,* in part) 36

— Setae 5-, 6-C usually with fewer branches, but if with 5 or 4 branches, respectively, then tufts 1-S more than 5-branched.....38

36 Saddle setae (1-X) bifid.....*Cx. torrentium*

— Setae 1-X simple.....37

37 Antenna shorter, length about 475 (465-485) µm; pecten with 12-19 teeth (mean 14.75).....*Cx. molestus*

— Antenna longer, with about 570 (555-585) µm; pecten with 9-14 teeth (mean 9.5).....*Cx. pipiens*

38 Tufts of siphon (setae 1-S) in a ventral zigzag row, the first 2 or 3 tufts arising within pecten; siphon index 3.5-5.....39

— Subventral siphon tufts paired, more basal ones arising or not beyond pecten; siphon index 5.5-9.....40

39 Upper caudal seta (3-X) with 2 or 3 branches (subgenus *Barraudius*) .....*Cx. modestus modestus*

— Seta 3 -X with 4 -7 branches (subgenus *Culex*, in part).....*Cx. laticinctus*

40 Most pecten spines with 3 or more basal denticles; saddle seta (1-X) with 3 or 4 branches; head seta 5-C usually with 3 or 4 branches, occasionally bifid (subgenus *Culex*, in part) .....*Cx. univittatus*

— Most pecten spines with only 1 or 2 basal denticles, occasionally 3; seta 1-X single or bifid; seta 5–C simple or bifid (subgenus *Neoculex*).....41

41 Length of subventral tufts 1-S from about 1.5 to 3 times the diameter of siphon at their point of attachment; more distal pecten spines in a regular row and evenly spaced.....*Cx. impudicus*

— Tufts 1-S usually under 1.5 times the diameter of siphon, though at times they may be twice this diameter; more distal pecten spines often wider spaced and somewhat irregularly inserted .....*Cx. territans*

Acknowledgements

The work was supported by the Fundação para a Ciência e a Tecnologia, Ministério da Ciência e da Tecnologia, through the Unidade de Parasitologia e Microbiologia Médicas (UPMM). We are grateful to all the researchers, students, technicians and public entities, without whose collaboration the survey of the mosquitoes of our country would not have been possible.

References

Aitken, T.H.G. (1954) The Culicidae of Sardinia and Corsica (Diptera). *Bulletin of entomological Research* **45**, 437-494.

Capela, R.A. (1986) Contribuição para o Conhecimento da Sistemática, Fisiologia, Ecologia e Etologia de Duas Espécies Halófilas de Mosquitos (Diptera, Culicidae) de Portugal: *Aedes* (*Ocherotatus*) *caspius* (Pallas, 1771) e *Aedes* (*Ochlerotatus*) *detritus* (Haliday, 1833). Thesis, Faculdade de Ciências de Lisboa, U.L. 252pp.

Coluzzi, M. & Sabatini, A. (1968). Divergenze Morfologiche e Barriere di Sterilitá nel Complesso *Aedes mariae* (Diptera, Culicidae). *Rivista di Parassitologia* **29**, 49-70.

Cranston, P.S., Ramsdale, C.D., Snow, K.R. & White, G.B. (1987) *Keys to the adults, male hypopygia, fourth-instar larvae and pupae of the British Mosquitoes* (Culicidae) *with notes on their ecology and medical importance*. Freshwater Biological Association. Scientific Publication **48**. 152pp.

Darsie, R.E. & Samanidou-Voyadjoglou, A. (1997) Keys for the identification of the mosquitoes of Greece. *Journal of the American Mosquito Control Association* **13**, 247-254.

Dahl, C. (1997) Diptera Culicidae, Mosquitoes. In: *Aquatic Insects of northern Europe-A Taxonomic Handbook.* **2**, 163-186. Ed. Anders N. Nilsson. Apolla Books. Stenstrup. Denmark. 440pp.

Edwards, F.W. (1921) A revision of the mosquitoes of the Palaearctic Region. *Bulletin of entomological Research* **12**, 263-351.

Encinas Grandes, A. (1982) *Taxonomia y biologia de los mosquitos del area Salmantina* (Diptera, Culicidae). Ed. Universidade de Salamanca. 473pp.

Gaffigan, T.V. & Ward, R.A. (1985) Index to the Second supplement to *A catalog of the mosquitoes of the World*, with corrections and additions (Diptera: Culicidae). *Mosquito Systematics* **17**, 52-63.

Glick, J. I. (1992) Illustrated key to the female *Anopheles* of Southeastern Asia and Egypt (Diptera: Culicidae). *Mosquito Systematics* **24**, 125-153.

Gutsevich, A.V., Monchadskii, A.S. & Shtakelberg, A.A. (1974) *Fauna of the USSR. Diptera*. III (4). *Mosquitoes. Family Culicidae*. Leningrad. Akademiya Nauk SSSR. Zoologicheskii Institut. New Series **100**. 384pp.

Harbach, R.A. (1985) Pictorial keys to the genera of mosquitoes, subgenera of *Culex* and the species of *Culex (Culex)* occurring in southwestern Asia and Egypt, with note on the subgeneric placement of *Culex deserticola* (Diptera; Culicidae). *Mosquito Systematics* **17**, 83-107.

Harbach, R.A. (1988) The mosquitoes of the subgenus *Culex* in southwestern Asia and Egypt (Diptera: Culicidae). *Contributions of the American Entomological Institute* **24**. 240pp.

Harbach, R.E. & Knight, K.L. (1980) *Taxonomists' Glossary of Mosquito Anatomy*. Baltimore. Biological Research Institute of America. 415pp.

Harbach, R.A. & Knight.K.L. (1981) Corrections and additions to *Taxonomist's Glossary of Mosquito Anatomy*. *Mosquito Systematic* **13**, 201-231.

Hedeen, R.A. (1958) A review of the mosquito larvae of France I. Genera *Culiseta, Mansonia, Orthopodomyia* and *Uranotaenia*. *Mosquito News* **18**, 308-321.

Hedeen, R.A. (1959) A review of the mosquito larvae of France II. The genus *Aedes*. *Mosquito News* **19**, 179-183.

Janz, J.G., Ribeiro, H., Pires, C.A. & Ramos, H.C. (1983) A discriminant function for the separation of larval *Culex molestus* Forskål from *Culex pipiens* L. *Jornal Sociedade Ciências Médicas Lisboa* **147**, 235-238.

Knight, K.L. & Stone, A. (1977) *A catalog of the mosquitoes of the World (Diptera, Culicidae)*. 2nd Edition The Thomas Say Foundation VI. Entomological Society of America Maryland. 611pp.

Knight, K.L. (1978) Supplement to *A catalog of the mosquitoes of the World (Diptera, Culicidae)*. The Thomas Say Foundation. Supplement to VI. Maryland. 107 pp.

Marshall, J.F. (1938) *The British Mosquitoes*. British Museum (Natural History). London. 341pp.

Ramos, H.C. (1983-84) Contribuição para o estudo dos mosquitos limnodendrófilos de Portugal (*Diptera; Culicidae*). *Garcia de Orta, Série de Zoologia* **11**, 133-154.

Ramos, H.C. & Ribeiro, H. (1980) Description of the male, pupa and fourth instar larva of *Culiseta atlantica* (Edwards, 1932) (Diptera: Culicidae), an endemic species of the Azores Archipelago. *Mosquito Systematics* **12**, 320-329.

Ramos, H.C., Ribeiro, H., Pires, C.A. & Capela, R.A. (1977-78) Research on the mosquitoes of Portugal (*Diptera, Culicidae*) II.The mosquitoes of Algarve. *Anais Instituto Higiene e Medicina Tropical* **5**, 237-256.

Ramos, H.C., Ribeiro, H., Pires, C.A. & Capela, R.A. (1982) Research on the mosquitoes of Portugal (*Diptera, Culicidae*) VII. Two new anopheline records. *Anais Instituto Higiene e Medicina Tropical* **8**, 103-109.

Ramsdale, C. D. (1998) *Anopheles cinereus* Theobald 1901 and its synonym *hispaniola* Theobald 1903. *European Mosquito Bulletin* **2**, 18-19.

Ribeiro, H., Ramos, H. C., Capela, R.A. & Pires, C.A. (1977) Research on the mosquitoes of Portugal (*Diptera, Culicidae*) III. Further five new mosquito records. *Garcia de Orta, Série de Zoologia* **6**, 51-60.

Ribeiro, H., Ramos, H.C., Pires, C.A. & Capela, R.A. (1977-1978) Research on the mosquitoes of Portugal I. Four new culicine records. *Anais do Instituto de Higiene e Medicina Tropical* **5**, 203-214.

Ribeiro, H., Ramos, H. C., Capela, R.A. & Pires, C.A. (1980a) *Os mosquitos de Cabo Verde (Diptera, Culicidae) Sistemática, Distribuição, Bioecologia e Importância Médica*. Estudos, Ensaios e Documentos nº 135, J.I.C.U. Lisboa. 141 pp.

Ribeiro, H., Ramos, H. C., Pires, C.A., & Capela, R.A. (1980b) Research on the mosquitoes of Portugal (*Diptera, Culicidae*) IV. Two new anopheline records.*Garcia de Orta, Série de Zoologia* **9**, 129-138.

Ribeiro, H., Ramos, H.C., Pires, C.A. & Capela, R.A. (1983) Research on the mosquitoes of Portugal (*Diptera, Culicidae*) X. A new aedine record: *Aedes punctor* (Kirby,1837). *Anais do Instituto de Higiene e Medicina Tropical* **9**, 37-40.

Ribeiro, H., Ramos, H. C., Pires, C.A. & Capela, R.A. (1985) Research on the mosquitoes of Portugal (*Diptera, Culicidae*) IX. A new anopheline record. *Garcia de Orta, Série de Zoologia* **12**, 105-112.

Ribeiro, H., Ramos, H.C., Pires, C.A., & Capela, R.A. (1988) An annotated checklist of the mosquitoes of Continental Portugal (Diptera, Culicidae). *Actas III Congresso Ibérico de Entomologia*, 233-254.

Rioux, J.A. (1958) *Les Culicidés du "Midi" Méditerranéen. Étude systématique et écologique*. Paul Lechevalier. Paris. 304pp.

Romi, R., Pontuale, G. & Sabatinelli, G. (1997) Le zanzare Italiane: generalitá e identificazione degli stadi preimaginali (Diptera, Culicidae). *Fragmenta entomologica* **29**, Supplemento, 1-141

Schaffner, F. (1992) *Les moustiques de Haute-Alsace*. I. Systématique. Thesis, Université Louis Pasteur Strasbourg. 295pp.

Schaffner, F. (1993) Nouvelle clé de détermination pour les imagos femelles du genre *Aedes* du nord-est de la France (Diptera, Culicidae). *Bulletin de la Société entomologique de France* **98**, 29-34.

Senevet, G. & Andarelli, L. (1956) *Les Anophèles de l'Afrique du Nord et du Bassin Méditerranéen. Encyclopédie Entomologique (A)*, **33**. Ed. Paul Lechevalier. Paris. 280pp.

Senevet, G. & Andarelli, L. (1959) *Les Moustiques de l'Afrique du Nord et du Bassin Méditerranéen. Les genres* Culex, Uranotaenia, Theobaldia, Orthopodomyia *et* Mansonia. *Encyclopédie Entomologique (A)* **37**. Ed. Paul Lechevalier. Paris. 383 pp.

Snow, K.R. (1990) *Mosquitoes*. Naturalists' Handbooks **14**. Slough. England. 66pp.

Stojanovich, C.J. & Scott, H.G.(1995) *Mosquitoes of European Russia*. Authors' edition. U.S.A. 106 pp.

Ward, R.A. (1984) Second supplement to *A catalog of the mosquitoes of the World (Diptera: Culicidae). Mosquito Systematics* **16**, 227-270.

Ward, R.A. (1992) Third supplement to *A catalog of the mosquitoes of the World (Diptera: Culicidae). Mosquito Systematics* **24**, 177-230.