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A revised checklist of the French Culicidae

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There are few major works on French mosquitoes. Those that exist are species catalogues (Séguy, 1925a; Hedeen, 1958, 1959; Callot & Rioux, 1965), sometimes including distribution and bibliography (Rageau *et al.*, 1970; Moussiegt, 1986). A certain number of species listed in the literature cannot be considered as truly belonging to the French fauna. Furthermore, during the last few years, new species have been described, and taxonomic changes have occurred (synonyms, new sub-genera, etc.). The purpose of this paper is to update the list of species collected in France and Corsica.

Sub-family *ANOPHELINAE*

Genus *Anopheles* Meigen 1818

Sub-genus *Anopheles* Meigen 1818
1 *algeriensis* Theobald 1903
claviger sensu lato:
2 *claviger* (Meigen 1804)
3* *petragnanii* Del Vecchio 1939
4 *hyrcanus* (Pallas 1771)
maculipennis sensu lato:
5 *atroparvus* Van Thiel 1927
6** *labranchiae* Falleroni 1926
7 *maculipennis s.s.* Meigen 1818
8 *melanoon* Hackett 1934
9 *messeae* Falleroni 1926
10** *sacharovi* Favre 1903
11 *subalpinus* Hackett & Lewis 1935
12** *marteri* Sénevet & Prunelle 1927
13 *plumbeus* Stephens 1828

Sub-genus *Cellia* Theobald 1902
14** *superpictus* Grassi 1899

Sub-family *CULICINAE*

Tribe *Aedini*

Genus *Aedes* Meigen 1818

Sub-genus *Aedes* Meigen 1818
15 *cinereus* Meigen 1818
16 *esoensis rossicus* Dolbeskin, Gorickaja & Mitrofanova 1930
17 *geminus* Peus 1970

Sub-genus *Aedimorphus* Theobald 1903
18 *vexans vexans* (Meigen 1830)
19 *vittatus* (Bigot 1861)

Sub-genus *Finlaya* Theobald 1903
20 *geniculatus* (Olivier 1791)

Sub-genus *Ochlerotatus* Lynch Arribalzaga 1891
Intrudens Group
21 *diantaeus* Howard, Dyar & Knab 1912
22 *pullatus* (Coquillett 1904)

Ochlerotatus Group
Annulipes Sub-group
23 *annulipes* (Meigen 1830)
24 *cantans* (Meigen 1818)
25 *flavescens* (Müller 1764)
26 *surcoufi* Theobald 1912

Communis Sub-group
27 *cataphylla* Dyar 1916
28 *communis* (De Geer 1776)
detritus (Haliday 1833)
29 sp. *A* Pasteur *et al.* 1977
30 sp. *B* Pasteur *et al.* 1977
31 *nigrinus* (Eckstein 1918)
32 *punctor* (Kirby 1837)
33 *sticticus* (Meigen 1838)

Dorsalis Sub-group
34 *berlandi* Séguy 1921
caspius caspius (Pallas 1771)
35 sp. *A* Cianchi *et al.* 1980
36 *dorsalis* (Meigen 1830)
37 *mariae* (Sergent & Sergent 1903)
38 *pulcritarsis pulcritarsis* (Rondani 1872)

Sub-genus *Rusticoidus* Shevchenko & Prudkina 1973
39 *refiki* Medschid 1928
40 *rusticus* (Rossi 1790)

Sub-genus *Stegomyia*
41*** *aegypti* (Linnaeus 1762)

Tribe *Culicini*

Genus *Culex* Linnaeus 1758
Sub-genus *Barraudius* Edwards 1921
42 *modestus modestus* Ficalbi 1889
Sub-genus *Culex* Linnaeus 1758
43** *brumpti* Galliard 1931
44 *mimeticus* Noe 1899
45 *pipiens pipiens* Linnaeus 1758 inc. form *molestus* Forskål 1775
46 *theileri* Theobald, 1903
47 *torrentium* Martini 1925

Sub-genus *Maillotia* Theobald 1907
48 *hortensis hortensis* Ficalbi 1889

Sub-genus *Neoculex* Dyar 1905
49 *impudicus* Ficalbi 1890
50 *martinii* Medschid 1930
51 *territans* Walker 1856

Tribe *Culisetini*

Genus *Culiseta* Felt, 1904
Sub-genus *Allotheobaldia* Brolemann 1919
52 *longiareolata* (Macquart 1838)

Sub-genus *Culicella* Felt 1904
53 *fumipennis* (Stephens 1825)
54 *litorea* (Shute 1928)
55 *morsitans* (Theobald 1901)

Sub-genus *Culiseta* Felt 1904
56 *alaskaensis alaskaensis* (Ludlow 1906)
57 *annulata* (Schrank 1776)
58 *glaphyroptera* (Schiner 1864)
59 *subochrea* (Edwards 1921)

Tribe *Mansoniini*

Genus *Coquillettidia* Dyar 1905
Sub-genus *Coquillettidia* Dyar 1905
60 *buxtoni* (Edwards 1923)
61 *richiardii* (Ficalbi 1889)

Tribe *Orthopodomyiini*

Genus *Orthopodomyia* Theobald 1904
62 *pulcripalpis* (Rondani 1872)

Tribe *Uranotaeniini*

Genus *Uranotaenia* Lynch Arribalzaga 1891
Sub-genus *Pseudoficalbia* Theobald 1912
63 *unguiculata unguiculata* Edwards 1913

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* this taxon should be *petragnanii* and not *petragnani* following the Latin rules of declension for specific names. The species was named by Del Vecchio in honour of Pr. Petragnani
** species present in Corsica only
*** sporadic species, often introduced via ports, not regarded as endemic in view of the rarity of observations (Rageau *et al.*, 1970)

COMMENTS

I. Arrangement of the taxonomic list

The organisation of this list takes into account the systematic classification used in the reference work: "A catalog of the mosquitoes of the world" and its additions (Knight & Stone, 1977; Knight, 1978; Ward, 1984; Gaffigan & Ward, 1985; Ward, 1992). Taxa are presented alphabetically within each taxonomic grouping.

Harbach (1994) has recently revised the internal classification of the genus *Anopheles*. Considering the small number of species, it was decided not to represent the sections, series, groups and sub-groups. On the other hand, certain relationships are deliberately highlighted by reference to "species complexes".

Considering that the sub-genus *Ochlerotatus* represents by far the greatest number of species, and that the morphological differences are sometimes important, it was decided to arrange the species according to the groups and sub-groups used by Mohrig (1969).

The sub-genus *Rusticoidus* was described by Shevchenko & Prudkina (1973) following a study of the male genitalia in the genus *Aedes*. They proposed *Ae. refiki* as haplotype, and included in the sub-genus the related species previously incorporated in the *rusticus* group. Even though the catalogue of mosquitoes (Knight & Stone, 1977 and its additions) classifies *Ae. refiki* as being the only European species in this sub-genus, we share the opinion of other authors (Shevchenko & Prudkina, 1973; Encinas Grandes, 1982) that *Ae. rusticus* is also a member of that sub-genus.

II. The Species list

We have made several modifications to the last list of French Culicidae published by Callot & Rioux (1965). Their list recognised 62 taxa, including *Ae. vexans* which was accidentally omitted from the publication due to a typographical error.

Species added to the list

An. subalpinus is a taxon that has recently been elevated to species status (Bullini *et al.*, 1980; Cianchi *et al.*, 1987; Ribeiro *et al.*, 1988; Ward, 1992). Being morphologically very close to *An. melanoon*, the two species are often mistaken in the literature. *An. subalpinus* was first recorded in the Languedoc in 1957 (Rioux & Ruffié, 1957) and appears to be abundant in the south of France (Salieres *et al.*, 1978).

Ae. esoensis rossicus is the most recently discovered species in France (Schaffner & Pfirsch, 1995). It has been recorded only in the north of Alsace, where it is relatively rare. However, large populations of this species occur in the flood plains of the Rhine in Germany (Becker & Ludwig, 1981).

Ae. geminus is a species related to *Ae. cinereus*, as described by Peus (1970). Since its discovery in France (Roman & Pichot, 1976), this species has been only rarely recorded, probably due to the difficulties posed by its identification (the need to distinguish adult males). It seems, however, that *Ae. geminus* is more abundant than *Ae. cinereus* (Schaffner, 1992; Schaffner & Pfirsch, 1995). Besides, it seems likely than a certain number of earlier records of *Ae. cinereus* are actually attributable to *Ae.geminus*. The distributions of both these taxa are still to be established.

Sibling species have been differentiated within two taxa of the genus *Aedes* (*Ae. detritus* and *Ae. caspius caspius*) using new genetic identification techniques, in particular isoenzymes studies. In addition to the demonstrated reproductive isolation, ecological, ethological and distributional differentiation has been added, thus confirming the validity of the two *Ae. detritus* species.

- *Ae. detritus* (both species "A" and "B"of Pasteur *et al.* (1977)), were recorded in Camargue (Pasteur *et al.*, 1977). A geographical segregation has been found to exist along a north-south gradient, with "A" less common in the north (Atlantic coastline: Brutus *et al.*, 1994). Autogeny, frequent in "A", is exceptional in "B"; species "A" develops only in hyper-saline larval sites; and the possibility of finding some morphological differentiation characters cannot be excluded (Agoulon, 1996).

- *Ae. caspius caspius*: only species "A" of Cianchi *et al.*, 1980 has been identified in France, so far, on the Atlantic coastline (Agoulon, 1996).

A change in nomenclature

Arnaud *et al.* (1976) resurrected the taxon *Aedes surcoufi* from synonymy with *Aedes (Ochlerotatus) excrucians* (Walker 1856) and considered it to be the sole representative of the "*excrucians*" complex in France. Accordingly, the name *Ae. excrucians* is replaced by *Ae. surcoufi* in the list of species. Certain authors (Dahl, C. & Nielsen, B.O. personal communication) consider, however, that the possibility of finding *Ae. excrucians* in the Alps should not be excluded. In the absence of any morphological analysis of alpine populations, we hold the opinion of Arnaud *et al.* (1976).

Species removed from the list

Aedes (Ochlerotatus) leucomelas (Meigen 1804) is removed from the list since it is not found in France. The only reports noted the occurrence of aggressive *Ae. leucolemas* females in the Jura (Roman, 1944; Roman & Morel, 1946), but emphasised the difficulties of distinguishing this species from *Aedes cataphylla*. A few years later the same specimens were classified as *Ae. cataphylla* (Roman, 1958). Hedeen (1959) and Rageau *et al.* (1970) subsequently suggested that the species probably occurred in France, considering its extensive Palaearctic range. However, as subsequent studies failed to locate the species in France, it seems reasonable to exclude it from the list. Nevertheless, *Ae. leucomelas* occurs in Germany, a few kilometres from the French border (Oberrheingebiet) (Becker & Ludwig, 1981) and therefore could potentially be encountered in the north-east of France.

Culex (Culex) laticinctus Edwards 1913 has been recorded in three different places: Hyères, in Var (Séguy, 1920a), Fontainebleau, in Seine-et-Marne (Séguy, 1921) and Lucciana, in Corsica (Galliard, 1927). All other references to this species in France actually relate to one or more of these records. We consider that the presence of a species can only be authenticated after larvae, adult males and adult females have been observed, together with the possibility of studying preserved specimens. None of the three French records matches these requirements. In addition to this is the fact that the species distribution is disjunct (Fontainebleau). We therefore do not consider this species to be present in France, at least until there are further records and more studies have been made.

Culex (Culex) univittatus Theobald 1901 was recorded in Corsica (Galliard, 1927) on the basis of larvae attributed to *Culex perexiguus* Theobald, 1903. Subsequently, the same author identified adult females from two other Corsican sites, but mentioned that there was no certainty of these specimens being *Cx. univittatus (= perexiguus)* as he had failed to obtain adults from the previously mentioned larvae (Galliard, 1928). Later, the discovery in 1931 of similar larvae from one of the 1927 sites, and the obtaining of adults (2 males and 2 females) allowed the author to describe the specimens as belonging to the new taxon *Culex brumpti* Galliard 1931. As no precise detail was given for the females from 1928, they remained classified as *Cx. univittatus*. However, even though various authors have retained them in their faunistic lists (Edwards, 1928; Séguy, 1932; Callot & Rioux, 1965; Moussiegt, 1986), others have removed the taxon (Lanzalavi, 1965; Rageau *et al.*, 1970). In 1966, there was another mention of the species in an administrative document from Corsica (Ségui, 1966). The species was encountered three times, with a total of 4 larvae (no preserved specimens). Even though *Cx. univittatus* occurs in the Iberian Peninsula and in Italy (Dahl & White, 1978), we prefer not to include it in the French species list, due to the uncertainties in the literature.

III. Other species and sub-species not included

Apart from the list by Callot & Rioux (1965) and species recently reported, the literature contains records of five other taxa in France. Four of these are invalid and one is considered doubtful.

Aedes (Finlaya) echinus (Edwards 1920) was reported for the first time (Séguy, 1920b) after a female specimen in bad condition was found in Meudon (Seine-et-Oise). Like Rageau *et al.* (1970) we consider that this record is doubtful as it is well outside the known range of the species (Mediterranean basin, especially North Africa). A second report (Ségui, 1966) mentions three discoveries of the species (124 larvae) in Corsica in 1966. Even though this report seems more reasonable from the biogeographical point of view, no specimens were preserved and the taxon is therefore excluded form the list until further surveys provide confirmation.

Aedes (Ochlerotatus) nigripes (Zetterstedt 1938) was mentioned by Séguy (1923) (4 females from Fontainebleau, June 1869, Dufour's collection) and quoted by Hedeen (1959) on the same basis. On the other hand, Callot & Rioux (1965) excluded it from their list. Considering the extremely northerly circumpolar range of the species, it is most unlikely to belong to the French fauna.

Aedes (Ochlerotatus) caspius hargreavesi Edwards 1920 was described from Italy and is mentioned as present in France in the calalogues of Knight & Stone (1977) and Dahl & White (1978). Séguy (1923) considered that the species could possibly occur in the south of France. Lack of precise records and a general absence of data regarding this sub-species, the valadity of which requires confirmation, prevents us from retaining it in our lists.

Culex (Maillotia) deserticola Kirkpartick 1924 was recorded in Corsica by Ségui (1965) who stated that he had collected the species in the larval stage on five occasions during his surveys of that year. He also recorded larvae of *Cx. hortensis.* Differences between larvae of these two species are extremely small. For reasons of biogeographic disjunction (the species is known from North Africa and Asia Minor (Dahl & White, 1978)), and the absence of preserved specimen, we do not consider the species as part of the fauna of France.

Culex (Culex) prosecutor Séguy 1927 (=*Culex pseudomimeticus* Séguy 1925) was described by Séguy (1925b, 1927) from an incomplete larva found in the Camargue. Mattingly considers it to be a synonym of *Cx. impudicus* (in Sénevet & Andarelli, 1959). Although it is mentioned as present in France in various catalogues (Knight & Stone, 1977; Dahl & White, 1978; Minar, 1990), no new information has been published regarding this taxon. The description of the extremity of the abdomen matches that of larvae of the sub-genus *Neoculex*, which is represented in France (and in Europe) by *Cx. impudicus, Cx. martinii* and *Cx. territans*. No major taxonomic characters allow differentiation of the larvae of these three species. Both *Cx. impudicus* and *Cx. martinii* can be encountered in the area where Séguy found the larvae. Because of the lack of information about this specimen, we are unable to attribute it to any of these species. Therefore, we propose classifying *Cx. prosecutor* as *nomina dubia*.

IV. Species that could be encountered in France

We consider that the following species have a reasonable chance of being encountered in France (including Corsica):

Anopheles (Cellia) cinereus hispaniola (Theobald 1903): this species is common in Sardinia, and could therefore be discovered in Corsica (Aitken, 1954; Rageau *et al.*, 1970).

Aedes (Ochlerotatus) leucomelas (Meigen 1804) and *Culiseta (Culicella) ochroptera* (Peus 1935): both species occur in Germany, close to the French border (Oberrheinebene and Schwarzwald respectively) (Becker & Ludwig, 1981). Populations could perhaps be discovered in the north-east of France.

Aedes (Stegomyia) albopictus (Skuse 1894) and *Aedes (Ochlerotatus) atropalpus s.s.* (Coquillett 1902): these species were introduced into Italy with used tyres imported from North America. The former occurs in Piedmont and Sardinia; it first appeared in 1990 and has ever since expanded its range (Knudsen *et al.*, 1996). The latter was discovered in 1996 in Venice (Romi *et al.*, 1997). *Ae. albopictus* poses health threats, due to its high capacity to transmit arboviruses. France is considered a "high introduction risk" country (Knudsen *et al.*, 1996), and it is important to monitor closely the potential breeding niches (tyres, various containers, hollow trees) in the south of France and Corsica.

Aedes (Finlaya) echinus (Edwards 1920), *Culex (Culex) laticinctus* Edwards 1913 and *Culex (Culex) univittatus* Theobald 1901: as mentioned earlier, these Mediterranean species have not been positively recorded in France, but could nevertheless be present in the south of France and, in particular, Corsica.

V. Some features of the distribution and ecology of the mosquitoes of France

*Species occurring in Corsica only: *An. marteri, An. labranchiae, An. sacharovi, An. superpictus, Cx. brumpti.*
*Species confined to the south of France: *An. petragnanii, An. melanoon, An. subalpinus, An. hyrcanus, Ae. vittatus, Ae. berlandi, Ae. mariae, Ae. pulcritarsis pulcritarsis, Cx.. mimeticus, Ur. unguiculata.*
*Species limited to the north-east of France: *Ae. esoensis rossicus, Ae. diantaeus, Ae. nigrinus, Cs. alaskaensis, Cs. glaphyroptera.*
*Mountain species: *Ae. pullatus, Ae. surcoufi, Ae. cataphylla, Cs. glaphyroptera.*
*Saltwater species: *Ae. detritus, Ae. caspius caspius, Ae. dorsalis.*
*Treehole species: *An. plumbeus, Ae. geniculatus, Ae. berlandi, Ae. pulcritarsis pulcritarsis, Or. pulcripalpis.*
*Rare species: *Ae. vittatus, Ae. diantaeus, Ae. nigrinus, Ae. flavescens, Ae. refiki, Cx. brumpti, Cx.. martinii.*

Conclusion

The French *Culicidae* fauna comprises 63 species to date. Even though this fauna is relatively well known, this list is not definitive. Indeed, thorough investigations of poorly studied areas and border regions could result in the addition of many species currently recorded in neighbouring countries. Additionally, global climatic change will very probably result in a northward extension of the range of some species. Systematic monitoring would allow the detection of such new arrivals, whether due to range extensions or accidental introductions.

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Culicidae Workshop - Fourth International Congress of Dipterology

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We take this opportunity to remind culicidologists to participate in the Culicidae Workshop at the Fourth International Congress of Dipterology (6-13 September 1998, Keble College, Oxford, England) which will focus on 'Trends in Mosquito Ecology and Systematics.'

The keynote presentation: *Overview of the status and current advances in mosquito systematics* will be given by Tom Zavortink and there will be a full programme of both oral and poster presentations.