

Checklist of mosquitoes (Diptera, Culicidae) of Croatia

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Abstract

The mosquito fauna of Croatia currently includes 48 species. This is the first checklist of this type, and will not be the final version as our systematic, ecological and distributional investigations are ongoing. The checklist includes names of authors who first recorded the presence of a particular species of mosquito in Croatia, as well as a review of the relevant literature and documentation.

Introduction

Croatia is a country with a wide variety of ecosystems and habitats, and a rich and diverse flora and fauna which, because all climatic, geological and ecological factors have not yet been fully studied, has almost certainly not yet been fully listed. As our investigations are ongoing, we expect the mosquito fauna will in future expand to include more species. In this respect we note the finding in neighbouring countries of *Aedes albopictus*, recorded in Italy, Serbia and Montenegro, and *Culex torrentium* recorded in Vojvodina, Serbia and Montenegro in 1983 (Petrić, 1989).

The first documented data on the mosquito fauna of Croatia is in the list of Diptera of Bosnia and Herzegovina and Dalmatia compiled by Strobl (1898), which includes only two species of Culicidae: *Culex pulchritarsis* (now *Ochlerotatus pulchritarsis*) and *Cx. ornatus* (now *Oc. geniculatus*). In 1902, the same author added four new species to his list: *Cx. vexans* (now *Aedes vexans*), *Cx. spathipalpis* (now *Culiseta longiareolata*), *Cx. nemorosus* (now *Oc. communis*) and *Cx. pipiens*, of which all but *Cx. pipiens* were found within the borders of Croatia.

Langhoffer (1916) included the following species in the list of the dipteran fauna of Croatia: *Cx. nemorosus* (now *Oc. communis*), *Cx. pipiens*, *Cx. annulatus* (now *Cs. annulata*), *Cx. annulipes* (now *Oc. annulipes*), *Cx. bicolor* (now synonymised with *Cx. pipiens*) and *Cx. cantans* (now *Oc. cantans*). Martini (1924) recorded the presence of *Anopheles maculipennis* s.l. in the Neretva Delta, but did not distinguish between the taxa within the complex. He also recorded the presence there of *An. sacharovi* and *An. algeriensis*.

Karaman (1925) published a paper on mosquitoes and mosquito control in Dalmatia, recording for the first time *Mansonia richiardii* (now *Coquillettidia richiardii*), *Stegomyia fasciatus* (now *Ae. aegypti*), *Cx. modestus*, *Cx. hortensis* and *Cx. territans*. *Anopheles hyrcanus* s.l. was recorded near Metković. He also found *An. plumbeus*, *An. superpictus*, *Ae. dorsalis* (now *Oc. dorsalis*), *Ae. geniculatus* (now *Oc. geniculatus*), and *Uranotaenia unguiculata*. Later Apfelbeck (1925, 1929, 1931) successively found *An. claviger*, *Oc. detritus*, *An. subalpinus* (now classified as a morphological egg variant of *An. melanoon*) in Metković.

Zotta (1935) was the first to distinguish between the taxa belonging to *Anopheles maculipennis* complex identifying those present as *Anopheles maculipennis* variety *messeae*, var. *typicus* and var. *atroparvus*. Missiroli (1939), who continued studying this complex, documented an additional record of var. *atroparvus*. Trausmiller (1949) investigated the 'biological races' of the common mosquito (*Culex pipiens*) and for the first time in the country literature used the name *Culex pipiens molestus*; he also recorded the presence of *An. labranchiae*.

Pavišić (1951) discussed the pest mosquitoes in Croatia and listed several additional species, viz. *Ae. cinereus*, *Ae. caspius* (now *Oc. caspius*), *Ae. flavescens* (now *Oc. flavescens*), *Ae. mariae* (the later studies of Coluzzi *et al.* (1974) showed that older Adriatic records of this species in reality represent records of its allopatric sibling species *Oc. zammitii*), *Ae. punctor* (now *Oc. punctor*), *Ae. rusticus* (now *Oc. rusticus*), and *Cs. fumipennis*, *Cs. morsitans*, and *Orthopodomyia pulcripalpis*. Labuda (1981) discovered the presence of *Ae. zammitii* (now *Oc. zammitii*) in the Croatian coastal area. Baranov (1943) first recorded the presence of *Ae. sticticus* (now *Oc. sticticus*).

For the past 18 years Merdić has investigated mosquitoes in Croatia. He reported the following additions to the mosquito fauna of Croatia (Merdić, 1988): *Ae. excrucians* (now *Oc. excrucians*), *Ae. cataphylla* (now *Oc. cataphylla*) and *Ae. rossicus*. A further species *Ae. riparius* (now *Oc. riparius*) was recorded for the first time by Merdić (1992), and four

years later *Ae. leucomelas* (now *Oc. leucomelas*) and *Cx. martinii* were discovered (Merdić & Škoda, 1996). Also in 1996 *Oc. nigrinus*, and *Cs. glaphyoptera* were recorded in Gorski kotar (Merdić, 1996). *Ochlerotatus behningi* was recorded for the first time in Croatia in the Maksimir Park in Zagreb (Merdić, 2002).

The presence of *Cs. subochrea*, found in Dalmatia, is reported here for the first time making a total of 48—currently recognised species so far found in Croatia

The checklist is based on bibliographic data as well as on accumulating knowledge about the existing species. By the mid 20th century 60% of the known mosquito fauna of Croatia had been determined. Like in many other European countries at that time, the interest of scientists in mosquitoes (especially those of the subfamily Anophelinae) was the result of widespread malaria. In order to eradicate the disease, it was necessary to study the biology of the *Anopheles* vector species. After malaria had been eradicated, new species of mosquitoes were recorded, and previous findings were confirmed. Mosquitoes were investigated regardless of their role as vectors, but the potential possibility of disease transmission was always stressed and more recent papers have focused mainly on applied entomology.

In the literature review references to available publications are marked (*) and other bibliographic data is unmarked. Because of difficulties in finding the oldest literature some of which no longer exists, judicious interpretation of some documents had to be exercised.

CHECKLIST (SPECIES RECORDED IN THE CROATIAN LITERATURE)

A total of 48 mosquito species have been recorded in Croatia, belonging to 8 genera, as follows: *Anopheles* (11), *Aedes* (4), *Ochlerotatus* (19), *Coquillettia* (1), *Culex* (5), *Culiseta* (6), *Orthopodomyia* (1) and *Uranotaenia* (1).

The list was compiled according to the current list of mosquitoes in Europe: *A revised checklist of European mosquitoes* by Snow & Ramsdale (2003), and it is based on the classification and nomenclature of mosquito species included in *A catalogue of the mosquitoes of the World* (Knight & Stone, 1977) and its supplements (Knight, 1978; Ward, 1884, 1992; Gaffigan & Ward, 1985).

Family CULICIDAE

Subfamily ANOPHELINAE

Genus *Anopheles* Meigen, 1818

Subgenus *Anopheles* Meigen, 1818

1. *algeriensis* Theobald, 1903
2. *atroparvus* Van Thiel, 1927 (Note 1)
3. *claviger* Meigen, 1804
4. *hyrcanus* Pallas, 1771 (Note 2.)
5. *labranchiae* Falleroni, 1926
6. *maculipennis* Meigen, 1818
7. *melanoon* Hackett, 1934
8. *messeae* Falleroni, 1926
9. *plumbeus* Stephens, 1828
10. *sacharovi* Favre, 1903 (Note 3)

Subgenus *Cellia* Theobald, 1902

11. *superpictus* Grassi, 1899

Subfamily CULICINAE

Genus *Aedes* Meigen, 1818

Subgenus *Aedes* Meigen, 1818

12. *cinereus* Meigen, 1818
13. *rossicus* Dolbeshkin, Gorickaja and Mitrofanova, 1930

- Subgenus *Aedimorphus* Theobald, 1903
 14. *vexans* Meigen, 1830 (Note 4)
 Subgenus *Stegomyia* Theobald, 1901
 15. *aegypti* Linnaeus, 1762

Genus *Ochlerotatus* Lynch-Arribáizaga, 1891

- Subgenus *Finlaya* Theobald, 1903
 16. *geniculatus* Olivier, 1791
 Subgenus *Ochlerotatus* Lynch-Arribáizaga, 1891
 17. *annulipes* Meigen, 1830
 18. *behningi* Martini, 1926
 19. *cantans* Meigen, 1818
 20. *caspius* Pallas, 1771
 21. *cataphylla* Dyar, 1916
 22. *communis* De Geer, 1776
 23. *detritus* Haliday, 1833 (Note 5)
 24. *dorsalis* Meigen, 1830
 25. *excrucians* Walker, 1856
 26. *flavescens* Müller, 1764
 27. *leucomelas* Meigen, 1804
 28. *nigrinus* Eckstein, 1918
 29. *pulchritarsis* Rondani, 1872
 30. *punctor* Kirby, 1837
 31. *riparius* Dyar and Knab, 1907
 32. *sticticus* Meigen, 1838 (Note 6)
 33. *zammitii* Theobald, 1903 (includes early record of *mariae*)
 Subgenus *Rusticoidus* Shevchenko & Prudkina, 1973
 34. *rusticus* Rossi, 1790

Genus *Coquillettidia* Dyar, 1905

- Subgenus *Coquillettidia* Dyar, 1905
 35. *richiardii* Ficalbi, 1889

Genus *Culex* Linnaeus, 1758

- Subgenus *Barraudius* Edwards, 1921
 36. *modestus* Ficalbi 1890
 Subgenus *Culex* Linnaeus, 1758
 37. *pipiens* Linnaeus, 1758 (Note 7)
 Subgenus *Maillotia* Theobald, 1907
 38. *hortensis* Ficalbi, 1889
 Subgenus *Neoculex* Dyar, 1905
 39. *martinii* Medschid, 1930
 40. *territans* Walker, 1856

Genus *Culiseta* Felt, 1904

- Subgenus *Allotheobaldia* Brölemann, 1919
 41. *longiareolata* Macquart, 1838
 Subgenus *Culicella* Felt, 1904
 42. *fumipennis* Stephens, 1825
 43. *morsitans* Theobald, 1901
 Subgenus *Culiseta* Felt, 1904
 44. *annulata* Schrank, 1776
 45. *glaphyoptera* Schiner, 1864
 46. *subochrea* Edwards, 1921 (Note 8)

Genus *Orthopodomyia* Theobald, 1904

47. *pulcripalpis* Rondani, 1872

Genus *Uranotaenia* Lynch-Arribálzaga, 1891

Subgenus *Pseudoficalbia* Theobald, 1912

48. *unguiculata* Edwards, 1913

NOTES

1. *Anopheles atroparvus* of the *Anopheles maculipennis* complex, i.e. one individual (female) was found in Podravina in the village of Vrbanovac located in the river plain near the Plitvica river—a tributary of the Drava (Zotta, 1935). The same finding (species and number) appeared in 1981-1982 in the village of Otok in Podravina (Adamović & Paulus, 1983). Missiroli (1939) also recorded the species. Trausmiller (1946) noted that he had not found the species in any part of continental Croatia. Since this species is frequently found in Vojvodina, Serbia and Montenegro (Adamović, 1979), i.e. in the area of salt habitat, the fact that such areas do not exist in Croatia could explain the rarity of the species.
2. The taxon *Anopheles hyrcanus*, Pallas 1771 is reported to comprise an unknown number of cryptic species about which there is no separate information (Ramsdale, 2001). Until this situation is resolved we are obliged to treat this taxon as a single species.
3. The species *Anopheles sacharovi* was recorded for the first time in 1924, when Martini conducted research in the Neretva delta, i.e. in the towns of Metković, Vid, Vidonje and Opuzen. After the 1st and 2nd World Wars, the lower Neretva was considered the region of endemic malaria. The epidemiological risk from the species *Anopheles* was considerable, which asked for more extensive research in the area. The following authors recorded the same species: Apfelbeck (1925), Karaman (1925) and Zotta (1935), who also found it in the Neretva delta, which was confirmed by Tartaglia (1949). The species *Anopheles sacharovi*, *Anopheles atroparvus*, *Anopheles maculipennis*, *Anopheles labranchiae*, *Anopheles messeae* and *Anopheles subalpinus*, belong to the *Anopheles maculipennis* complex. The species *Anopheles subalpinus* is a synonym for the species *Anopheles melanoon* (Linton *et al.*, 2002).
4. The species *Aedes vexans* was recorded as early as 1902, when Strobl named it *Culex vexans*. As the number of generations and their abundance depend to a large extent on the water level of rivers, it is the reason why this species is dominant near rivers, many of which can be found in Eastern Croatia.
5. *Ochlerotatus detritus* is a species recently found in Istria. It was first recorded by Apfelbeck (1929), who was studying Culicidae in Bosnia and Dalmatia. This taxon is now known to comprise two sibling species, *Oc. coluzzii* and *Oc. detritus* s.s., with overlapping distributions (Rioux *et al.*, 1990). *Ochlerotatus coluzzii* has, as yet, been found only in North Africa and in Western Europe and, until proved otherwise, we continue to regard the Croatian populations to be of *Oc. detritus* s.s.
6. Larvae of *Ochlerotatus sticticus* develop in floodplains near rivers, or in puddles that remain after snow melt. They can often be found with larvae of *Aedes vexans*. Baranov first recorded it in Croatia in 1943, whilst investigating breeding sites of flood mosquitoes on the banks of the river Drava at Osijek.
7. Langhoffer first recorded *Culex pipiens* in 1916. It is the most significant representative of the urban mosquito fauna, especially in towns and villages on the Adriatic coast, where it is a great problem during the holiday season. Since its larvae develop in stagnant waters, small breeding sites that are present in urban areas, this is not surprising. As *Culex pipiens* is one of the main vectors of the West Nile virus, it requires further investigation. The name *Culex molestus* is still used in some studies as a form within *Culex pipiens* complex and is useful in stressing physiological and behavioural differences even though, from a taxonomic point of view, it is incorrect (Ward, 1992). For purely taxonomic reasons we include *Culex pipiens* only in our checklist.
8. *Culiseta subochrea* was found in Dalmatia (Merdić), but this has not yet been published.

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