

## Revised checklist and new faunistic data of the Romanian Culicidae (Insecta, Diptera)

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**SUMMARY.** We present here an update checklist increases the number of Culicidae species in Romania from 50 to 60, split into 7 genera: *Aedes* (29 species), *Anopheles* (10 species), *Coquillettidia* (2 species), *Culex* (9 species), *Culiseta* (8 species), *Orthopodomyia* (1 species) and *Uranotaenia* (1 species). Additionally, 20 new faunistic records to different regions of Romania, mostly from Transylvania.

**Keywords:** faunistic data, checklist, mosquito, Transylvania

### Introduction

Culicidae is a well-known worldwide distributed family of Diptera, present in different ecosystems from natural permanent waters to many ephemeral or artificial waters. The present number of taxa is 3601 (species and subspecies) included in 110 different genera (<http://mosquito-taxonomic-inventory.info/>). A number of 100 species belonging to nine genera have been recorded on the continental Europe (Harbach, 2013). In Romania, first faunistic surveys of Culicidae were initiated by Zotta (1927, 1932), along with the first monitoring of malaria cases from the country. A comprehensive revision of the Culicidae fauna of Romania was published in 1995 by Nicolescu, with a first checklist containing 50 species. Further, six other species with uncertain records were presented together with a synthesis of the literature data and an updated checklist for different major regions of Romania.

Nowadays, the Romanian mosquito surveys are mostly focused on the role of different Culicidae species as vectors for different pathogens, rather than faunistic surveys. In 1998, Nicolescu, while working on the distribution of the West Nile

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virus, published important new faunistic data on the distribution of mosquitoes from the southern part of Romania, followed by contributions from other 14 different ecological regions (Nicolescu *et al.*, 2002, 2003a, 2003b, 2003c). Further on, a new species, *Anopheles daciae* Linton, Nicolescu and Harbach, 2004 was detected and described using two molecular markers (nuclear rDNA ITS2 and mitochondrial COI) and morphological characters of the eggs (Nicolescu *et al.*, 2004). In the same publication, another Culicidae species, *An. melanoon* Hackett, 1934 was mentioned for the first time to the fauna. Additionally, recent data on further 10 *Anopheles* species from Romania were published by different authors (Ciolpan *et al.*, 1998; Gunay *et al.*, 2017; Vincent *et al.*, 2011; Marí and Peydró, 2012).

Preliminary data on the mosquito fauna from the Danube Delta were published by Pârvu (2005, 2008) and Prioteasa *et al.* (2007). The *Anopheles maculipennis* complex from the Danube Delta - was investigated by Fălcută *et al.* (2008, 2010). *Ochlerotatus zammitii* (Theobald, 1903) was also recorded for the first time from here, followed by a comprehensive checklist of the area, containing 31 different mosquito species (Prioteasa and Fălcută 2010). Distribution data of different *Anopheles* species from Bucharest and the surrounding area were published by Fălcută *et al.* (2011). Moreover, the invasive *Aedes albopictus* was detected for the first time in Bucharest (Prioteasa *et al.*, 2015). Moreover, data on distribution of mosquito species responsible for West Nile virus circulation added Sîrbu *et al.* (2011); Dinu *et al.* (2015); Cotar *et al.* (2016). A comprehensive monitoring survey on the Culicidae fauna from the Danube Delta area was initiated by the authors in 2014, focusing on the most representative ecosystems from the area. Here, we present the results of our integrative approach for species identification (morphological characters) and first records of *Aedes hungaricus* (Mihályi, 1955) and *Anopheles algeriensis* Theobald, 1903 from Romania (Török *et al.*, 2016).

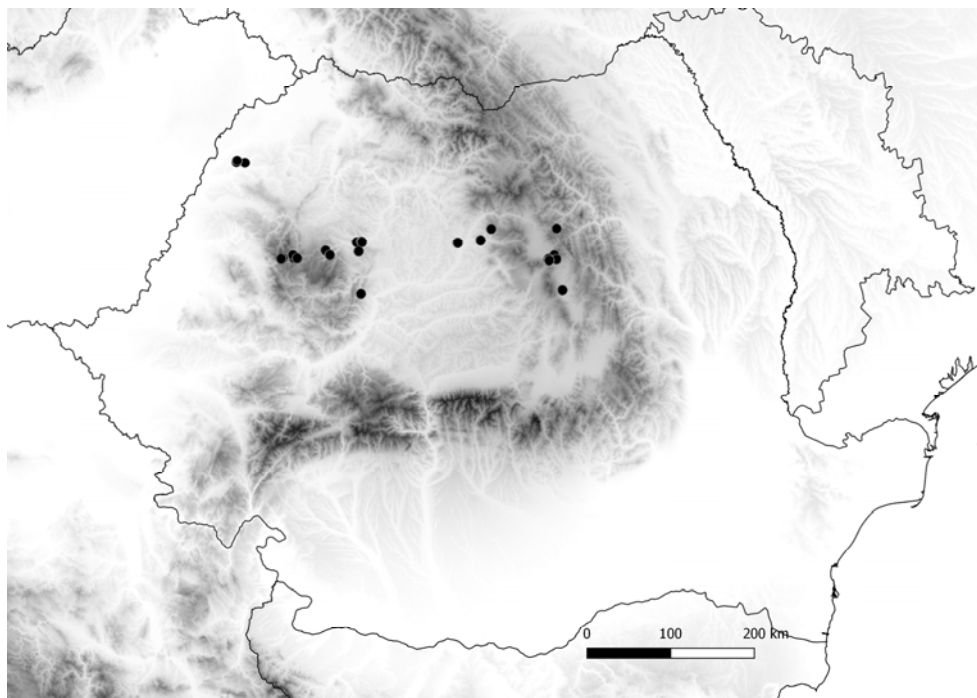
Despite the generally well-known Culicidae fauna of Romania, faunistic investigations of different regions are biased. Most of the literature data comes from southern Romania (Nicolescu *et al.*, 2003b, 2003c), and the Transylvanian mosquitoes have been sporadically explored.

The present paper is a synthesis of our integrative surveys of the last few years (1995-2018), focused mostly on some less studied areas in Romania, such as Transylvania. These data were completed with the most recent faunistic literature on the Romanian Culicidae and an updated checklist is presented here.

## Materials and methods

In this study, we used the systematic classification proposed by Harbach 2018 (Mosquito Taxonomic Inventory, [www.mosquito-taxonomic-inventory.info](http://www.mosquito-taxonomic-inventory.info) Updated 17 October 2018). Specimens were collected between 2015 and 2018 using sweep nets and Malaise traps. The material was stored in 70% ethanol or pinned. All material is

deposited in the Diptera Collection of the Faculty of Biology and Geology, Babeş-Bolyai University, Cluj-Napoca, Romania (DCBBU). The Culicidae material was identified based on morphological characteristics of males and females using identification keys (Becker *et al.*, 2010, Kenyeres and Tóth, 2008) as well as different software programs (Schaffner *et al.*, 2001). All our faunistic data are available on the TransDiptera Online Database (Kolcsár *et al.*, 2018, <http://transdiptera.ro>, doi: 10.18426/OBM.5sskml13ip0). Our collecting sites are presented in Figure 1.



**Figure 1.** Culicidae collection sites.

### **Results and discussion**

We present here new faunistic data of 20 different Culicidae species from Transylvania, based on 86 males and 268 females. Furthermore, an updated checklist of the Culicidae fauna of Romania is presented below.

Checklist of the Romanian Culicidae fauna  
Subfamily Anophelinae  
Genus *Anopheles* (Meigen)  
Subgenus *Anopheles* (Meigen)

1. *algeriensis* Theobald, 1903 **Note 1**
2. *atroparvus* van Thiel, 1927
3. *claviger* (Meigen, 1804) **Note 2**
4. *daciae* Linton, Nicolescu and Harbach, 2004
5. *hyrcanus* (Pallas, 1771)
6. *maculipennis* Meigen, 1818 **Note 3**
7. *melanoon* Hackett, 1934
8. *messeae* Falleroni, 1926
9. *plumbeus* Stephens, 1828
10. *sacharovi* Favre, 1903

Subfamily Culicinae

Tribe Aedini

Genus *Aedes* (Meigen)

Subgenus *Acartomyia* Theobald

11. *zammitii* (Theobald, 1903)

Subgenus *Aedes* (Meigen)

12. *cinereus* Meigen, 1818
13. *geminus* Peus, 1970 **Note 4**
14. *rossicus* (Dolbeskin, Gorickaja and Mitrofanova, 1930) **Note 5**

Subgenus *Stegomyia* Theobald

15. *albopictus* (Skuse 1895)

Subgenus *Aedimorphus* (Theobald)

16. *vexans* (Meigen, 1830) **Note 6**

Subgenus *Dahlia* Reinert, Harbach and Kitching

17. *geniculata* (Olivier, 1791) **Note 7**

Subgenus *Woodius* Reinert, Harbach and Kitching

18. *intrudens* (Dyar, 1919)

Subgenus *Ochlerotatus* Lynch Arribalzaga

19. *annulipes* (Meigen, 1830) **Note 8**
20. *behningi* (Martini, 1926) (Schaffner *et al.*, 2001, Gunay *et al.*, 2017) **Note 9**
21. *cantans* (Meigen, 1818) **Note 10**
22. *caspius* (Pallas, 1771) **Note 11**
23. *cataphylla* (Dyar, 1916) **Note 12**
24. *communis* (de Geer, 1776) **Note 13**
25. *detritus* (Haliday, 1833)
26. *dorsalis* (Meigen, 1830)

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27. *duplex* (Martini, 1926)
28. *excrucians* (Walker, 1856)
29. *flavescens* (Muller, 1764)
30. *hungaricus* (Mihályi, 1955)
31. *intrudens* (Dyar, 1919)
32. *leucomelas* (Meigen, 1804)
33. *nigrinus* (Eckstein, 1918) **Note 14**
34. *pulcritarsis* (Rondani, 1872)
35. *pullatus* (Coquillett, 1904) **Note 15**
36. *punctor* (Kirby, 1837) **Note 16**
37. *riparius* (Dyar and Knab, 1907) **Note 17**

Subgenus *Rusticoidus* Shevchenko and Prudkina, 1973

38. *refiki* (Medschid, 1928)

Tribe Culicini

Genus *Culex* Linnaeus

Subgenus *Barraudius* (Edwards)

39. *modestus* Ficalbi, 1890 **Note 18**

Subgenus *Culex* (Linnaeus)

40. [*impudicus* (Ficalbi, 1890)] (**QR**) **Note 19**
41. *laticinctus* Edwards, 1913
42. *mimeticus* (Noe, 1899) **Note 20**
43. *pipiens* Linnaeus, 1758 **Note 21**
44. *theileri* Theobald, 1903
45. *torrentium* Martini, 1925 **Note 22**

Subgenus *Neoculex* (Dyar)

46. *martinii* Medschid, 1930
47. *territans* Walker, 1856

Subgenus *Maillotia* Theobald, 1907

48. *hortensis* Ficalbi, 1889 **Note 23**

Tribe Culisetini

Genus *Culiseta* Felt

Subgenus *Allotheobaldia* (Broelemann)

49. *longiareolata* (Macquart, 1938)

Subgenus *Culiseta* (Felt)

50. *alaskaensis* (Ludlow, 1906)
51. *annulata* (Schrank, 1776) **Note 24**

- 52. *fumipennis* (Stephens, 1825)
- 53. *glaphyoptera* (Schiner, 1864) **Note 25**
- 54. *morsitans* (Theobald, 1901)
- 55. *subochrea* (Edwards, 1921)

Subgenus *Culicella* Felt

- 56. *ochroptera* (Peus, 1935)

Tribe Mansonini (Dyar)

Genus *Coquillettidia* (Dyar)

- 57. *buxtoni* (Edwards, 1923)
- 58. *richiardii* (Ficalbi, 1889)

Tribus Orthopodomyiini

Genus *Orthopodomyia* Theobald, 1904

- 59. *pulcripalpis* (Rondani, 1872)

Tribus Uranotaeniini

Genus *Uranotaenia* (Lynch Arribalzaga)

- 60. *unguiculata* Edwards, 1913

**Note 1:** *An. algerinesis* was named after Algeria where it was collected for the first time, but the species has larger distribution in Europe (with several data from the Mediterranean area), Middle-East and North Africa. This species was recorded in Romania for the first time in the Danube Delta, close to Sulina (Török *et al.*, 2016). The specimens were collected in April and September 2014 (Török *et al.*, 2016).

**Note 2:** *An. claviger* is a well-known species with medical importance as it is a vector species of the malaria pathogens and some mosquito-borne viruses, such as Batai and Tahyna viruses. The species avoids lowland ecosystems (Hubalek 2008, Becker *et al.*, 2010). This species was collected by the authors in Florești, near the Someșul Mic River, at 354 m a.s.l. (with coordinates 46.759912° N, 23.531731° E) on 24 August 2017, 3 males, leg. Kolcsár L.-P.L.-P, Török E.

**Note 3:** *An. maculipennis* s.l. contains a series of sibling species (female imagoes are morphologically similar) which are all important vectors of malaria pathogens and mosquito-borne viruses like Batai, Tahyna and West Nile viruses (Hubalek 2008, Becker *et al.*, 2010). We observed that the flying period of this species complex is from spring to autumn, and can be found resting in shaded places and flying below the crown of the trees.

We collected 2 females at Florești, near the Someșul Mic River, at 354 m a.s.l. (coordinates 46.759912° N, 23.531731° E), on 24 August 2017, leg. Kolcsár L.-P. and 1 male at Ciaracio, Ciuc Basin, near Agris brook valley, at 679 m, (coordinates 46.412255° N, 25.739988° E), on 10 August 2017, leg. Ujvárosi B.

**Note 4:** *Ae. geminus* is a less known species and its vector potential is unknown. During our investigation we collected 2 males, 1 female at Voşlobeni, Giurgeu Basin, Senetea, at 764 m a.s.l., (coordinates 46.625875° N, 25.597453° E) on 6 July 2017, leg. Keresztes L.; 1 male, in the same location, on 16 July 2016, leg. Kolcsár L.-P.; 1 male, in Voşlobeni, Giurgeu Basin, near Mureş River, at 754 m, (coordinated 46.636571° N, 25.59146° E), on 6 June 2017, leg. Kolcsár L.-P., Török E.; 1 female at Cluj-Napoca, Alexandru Borza Botanical Garden (Malaise trap), at 395 m, (coordinates 46.761322° N, 23.586521° E) on 19 May 2015, leg. Kolcsár L.-P.; 1 female, Ciaracio, Ciuc Basin, near Agris brook valley, at 679 m, (coordinates 46.412255° N, 25.739988° E), on 10 August 2017 leg. Ujvárosi B.; 5 females, Breaza, Breaza forest, at 392 m, (coordinates 46.755395° N, 24.616005° E) on 9 June 2017, leg. Kolcsár L.-P., Török E.; 1 female, in Gurghiu, dendrological park, at 430 m, (46.773673° N, 24.861017° E) on 5 July 2017, leg. Török E.

**Note 5:** *Ae. rossicus* has been recorded in neighboring countries, such as Hungary (Tóth and Kenyeres 2012). The Online Catalog of Culicidae (Schaffner *et al.*, 2001) and MosKeyTool (Gunay *et al.*, 2017) list report the species also from Romania. Nicolescu (1995) considered the species as present in Romania based on previous literature data (Mihály 1959). Based on this remarks we include the species in the present checklist.

**Note 6:** *Ae. vexans* is a common species in Romania. It is a multivoltin species with several generations per year. It was collected frequently in forest ecosystems. It is a very aggressive species, feeding mostly on human blood and transmitting Tahyna and West Nile viruses (Hubalek, 2008, Becker *et al.*, 2010).

Material used in the present study: Voşlobeni, Giurgeu Basin, Senetea, 764 m, 46.625875° N, 25.597453° E, 16 July 2017, 1 male, leg. Kolcsár L.-P., Török E.; same location, 20 July 2017, 2 males, leg. Kolcsár L.-P.; same location, 22 April 2016, 1 male, leg. Kolcsár L.-P., Török E.; Voşlobeni, Giurgeu Basin, Mureş River, 754 m, 46.636571° N, 25.59146° E, 6 June 2017, 3 females, leg. Kolcsár L.-P., Török E.; Breaza, Breaza forest, 392 m, 46.755395° N, 24.616005° E, 9 June 2017, 9 females, leg. Kolcsár L.-P., Török E.; Doda Pili, Apuseni Mts., 1023 m, 46.646172° N, 22.848041° E, 1 July 2016, 1 female, leg. Kolcsár L.-P., Török E.; Gurghiu, dendrological park, 430 m, 46.773673° N, 24.861017° E, 5 July 2017, 6 males, 36 females, leg. Ujvárosi B., Török E.; Crestur, Csátári forest, 164 m, 47.359438° N, 22.245955° E, 17 July 2017, 9 females, leg. Török E.; Cluj-Napoca, Alexandru Borza Botanical Garden (Malaise trap), 395 m, 46.761322° N, 23.586521° E, 11 June 2015, 2 males, leg. Kolcsár L.-P.; same location, 22 May 2017, 2 males, leg. Kolcsár L.-P.; Floreşti, Someşul Mic River, 354 m, 46.759912° N, 23.531731° E, 24 August 2017, 1 male, leg. Kolcsár L.-P.; Ciaracio, Ciuc Basin, Agris brook valley, 679 m, 46.412255° N, 25.739988° E, 10 August 2017, 4 females, leg. Ujvárosi B.

**Note 7:** *Ae. geniculata* is a typical forest species, breeds in tree-holes. Females prefer to feed on humans. They have one or two generations per year. The species was detected positive for West Nile virus (Hubalek 2008, Becker *et al.*, 2010). Material: Voşlobeni, Giurgeu Basin, Mureş River, 754 m, 46.636571° N, 25.59146° E, 6 June 2017,

3 females, leg. Kolcsár L.-P., Török E.; Voşlobeni, Giurgeu Basin, Senetea, 764 m, 46.625875° N, 25.597453° E, 6 July 2017, 1 female, leg. Keresztes L.; same location, 20 July 2017, 1 male, leg. Keresztes L.; Gurghiu, dendrological park, 430 m, 46.773673° N, 24.861017° E, 5 July 2017, 2 males, 2 females, leg. Ujvárosi B., Török E.; Glajarie, Gurghiu Mts., 885 m, 46.857766° N, 24.974917° E, 6 July 2017, 1 female, leg. Kolcsár L.-P., Török E.; Cluj-Napoca, Mikó Garden, 337 m, 46.763588° N, 23.580218° E, 10 August 2015, 2 females, leg. Kolcsár L.-P.; Cluj-Napoca, Feleacu hills, Sáros-bükk marsh, 459 m, 46.69262° N, 23.55124° E, 15 April 2017, 2 females, leg. Keresztes L., Ujvárosi B.; Măguri - Răcăţău, Gilău Mts., Someşul Rece River, 585 m, 46.665605° N, 23.242337° E, 11 August 2017, 1 male, leg. Kolcsár L.-P.

**Note 8:** *Ae. (Oc.) annulipes* is a widely distributed species, occurs mostly in forest ecosystems, it is univoltin. It is the suspected vector of Tahyna virus (Hubalek 2008, Becker *et al.*, 2010).

Material: Voşlobeni, Giurgeu Basin, Mureş River, 754 m, 46.636571° N, 25.59146° E, 6 June 2017, 3 males, 7 females, leg. Kolcsár L.-P., Török E.; Voşlobeni, Giurgeu Basin, Senetea, 764 m, 46.625875° N, 25.597453° E, 20 July 2017, 2 females, leg. Kolcsár L.-P., Török E.; Gurghiu, dendrological park, 430 m, 46.773673° N, 24.861017° E, 5 July 2017, 16 females, leg. Ujvárosi B., Török E.; Glajarie, Gurghiu Mts., 885 m, 46.857766° N, 24.974917° E, 6 July 2017, 2 females, leg. Kolcsár L.-P., Török E.; same location, 29 June 2017, 2 females, leg. Kolcsár L.-P., Török E.; Ciaracio, Ciuc Basin, Agris brook valley, 679 m, 46.412255° N, 25.739988° E, 10 August 2017, 1 female, leg. Ujvárosi B.; Crestur, Csatári forest, 164 m, 47.359438° N, 22.245955° E, 17 July 2017, 6 females, leg. Török E.

**Note 9:** *Ae. (Oc.) behningi* has been recorded from Moldova (Sulesco *et al.*, 2013). The Online Catalog of Culicidae (Schaffner *et al.*, 2001) and MosKeyTool (Gunay *et al.*, 2017) list the species from Romania. Nicolescu (1986) suggested the presence in the Romanian fauna based on former literature data (Zotta, 1932, Giurca, 1982).

**Note 10:** *Ae. (Oc.) cantans* has a long lasting active period, distributed mostly in forest ecosystems. It is a univoltin species; it has one generation per year. West Nile virus could be transmitted by this species (Hubalek 2008, Becker *et al.*, 2010).

Material: Gurghiu, dendrological park, 430 m, 46.773673° N, 24.861017° E, 5 July 2017, 5 females, leg. Kolcsár L.-P., Török E.; Voşlobeni, Giurgeu Basin, Mureş River, 754 m, 46.636571° N, 25.59146° E, 6 June 2017, 1 male, 7 females, leg. Kolcsár L.-P., Török E.; Cluj-Napoca, Feleacu hills, Sáros-bükk marsh, 459 m, 46.69262° N, 23.55124° E, 15 April 2017, 1 female, leg. Keresztes L., Ujvárosi B.; Cluj-Napoca, Mikó garden, 337 m, 46.763588° N, 23.580218° E, 16 May 2016, 1 male, 1 female, leg. Kolcsár L.-P.; Ciaracio, Ciuc Basin, Agris brook valley, 679 m, 46.412255° N, 25.739988° E, 10 August 2017, 2 females, leg. Ujvárosi B.; Gurghiu, dendrological park, 430 m, 46.773673° N, 24.861017° E, 5 July 2017, leg. Ujvárosi B., Török E.



**Note 11:** *Ae. (Oc.) caspius* is a multivoltin vector species. It prefers saline habitat, but a small number of individuals could be frequently detected from forest hillsides. West Nile virus and Tahyna virus could be transmitted by this species (Hubalek 2008, Becker *et al.*, 2010).

Material: Gurghiu, dendrological park, 430 m, 46.773673° N, 24.861017° E, 5 July 2017, 1 female, leg. Ujvárosi B., Török E.

**Note 12:** *Ae. (Oc.) cataphylla* is an univoltin species. It feeds mostly on human blood (Hubalek, 2008, Becker *et al.*, 2010). Peak of its biting activity is during dusk, also at strongly shaded places and can be troublesome before rains even during daytime. The species is active mostly in summer.

Material: Gurghiu, dendrological park, 430 m, 46.773673° N, 24.861017° E, 5 July 2017, 6 females, leg. Ujvárosi B., Török E.; Ciaracio, Ciuc Basin, Agris brook valley, 679 m, 46.412255° N, 25.739988° E, 10 August 2017, 1 female, leg. Ujvárosi B.; Voşlobeni, Giurgeu Basin, Senetea bog, 760 m, 46.625875° N, 25.597453° E, 16 July 2016, 1 female, leg. Kolcsár L.-P.; same location 6 July 2017, 1 female, leg. Keresztes L.; Doda Pili, Bihor Mts., Cheile Someşului Cald, 1200 m, 46.637443° N, 22.718924° E, 1 July 2016, 2 females, leg. Kolcsár L.-P., Török E.; Smida, Gilău Mts., Belis dam lake, 1000 m, 46.641554° N, 22.889426° E, 30 June 2016, 2 females, leg. Kolcsár L.-P., Török E.

**Note 13:** Biology of *Ae. (Oc.) communis* is not well known. We were able to collect only a small number of individuals.

Material: Voşlobeni, Giurgeu Basin, Mureş River, 754 m, 46.636571° N, 25.59146° E, 6 June 2017, 2 females, leg. Kolcsár L.-P., Török E.

**Note 14:** *Ae. (Oc.) nigrinus* was recorded in neighboring countries (Hungary, Tóth and Kenyeres 2012). The Online Catalog of Culicidae (Schaffner *et al.*, 2001) and MosKeyTool (Gunay *et al.*, 2017) list the species from Romania. Nicolescu (1995) listed this species from Romania based on former literature data (Mihály 1959). We agree with the presence of the species in Romania.

**Note 15:** *Ae. (Oc.) pullatus* has only one generation per year. It has not yet been detected as a vector species for any pathogens. The females are active all day.

Material: Smida, Gilău Mts., Belis dam lake, 1000 m, 46.641554° N, 22.889426° E, 30 June 2016, 5 females, leg. Kolcsár L.-P., Török E.; Doda Pili, Bihor Mts., Cheile Someşului Cald, 1200 m, 46.637443° N, 22.718924° E, 1 July 2016, 2 males, 2 females, leg. Kolcsár L.-P., Török E.; Padiş, Bihor Mts., Cheile Someşului Cald, 1159 m, 46.64° N, 22.736036° E, 1 July 2016, 1 male, leg. Kolcsár L.-P., Török E.; Gurghiu, dendrological park, 430 m, 46.773673° N, 24.861017° E, 5 July 2017, 2 females, leg. Ujvárosi B., Török E.

**Note 16:** *Ae. (Oc.) punctator* is a “snow-melt” mosquito, having only one generation per year. It is a vector species, which could transmit West Nile and Tahyna viruses (Hubalek 2008, Becker *et al.*, 2010). The females are active all day long.

Material: Cluj-Napoca, Alexandru Borza Botanical Garden (Malaise trap), 395 m, 46.761322° N, 23.586521° E, 22 May 2017, 1 male, leg. Kolcsár L.-P.; Voşlobeni, Giurgeu Basin, Senetea bog, 760 m, 46.625875° N, 25.597453° E, 22 April 2016, 6 males, 1 female, leg. Kolcsár L.-P.; Voşlobeni, Giurgeu Basin, Mureş River, 754 m, 46.636571° N, 25.59146° E, 6 June 2017, 9 females, leg. Kolcsár L.-P., Török E.; Doda Pili, Bihor Mts., Cheile Someşului Cald, 1200 m, 46.637443° N, 22.718924° E, 1 July 2016, 4 females, leg. Kolcsár L.-P., Török E.; Voşlobeni, Giurgeu Basin, Senetea bog, 760 m, 46.625875° N, 25.597453° E, 20 July 2017, 1 female, leg. Keresztes L.; Gurghiu, dendrological park, 430 m, 46.773673° N, 24.861017° E, 5 July 2017, 1 female, leg. Ujvárosi B., Török E.; Smida, Gilău Mts., Belis dam lake, 1000 m, 46.641554° N, 22.889426° E, 30 June 2016, 1 female, leg. Kolcsár L.-P., Török E.

**Note 17:** *Ae. (Oc.) sticticus* prefers water-pits in forests. The species has several generations per year, and migrates long distances from breeding-sites to available habitats.

Material: Breaza, Breaza forest, 392 m, 46.755395° N, 24.616005° E, 9 June 2017, 1 female, leg. Kolcsár L.-P., Török E.; Gurghiu, dendrological park, 430m, 46.773673° N, 24.861017° E, 5 July 2017, 3 females, leg. Ujvárosi B., Török E.; Voşlobeni, Giurgeu Basin, Mureş River, 754 m, 46.636571° N, 25.59146° E, 6 June 2017, 3 females, leg. Kolcsár L.-P., Török E.; Voşlobeni, Giurgeu Basin, Senetea bog, 760 m, 46.625875° N, 25.597453° E, 20 July 2017, 1 male, 3 females, leg. Keresztes L.

**Note 18:** *Cx. modestus* is a widely distributed, multivoltin species. Females bite humans and are considered very aggressive. This species could be found mostly around the larval breeding sites. It is a vector species for West Nile, Tahyna, and Sindbis viruses (Hubalek, 2008, Becker *et al.*, 2010).

Material: Voşlobeni, Giurgeu Basin, Mureş River, 754 m, 46.636571° N, 25.59146° E, 6 June 2017, 16 females, leg. Kolcsár L.-P., Török E.; Voşlobeni, Giurgeu Basin, Senetea bog, 760 m, 46.625875° N, 25.597453° E, 16 July 2016, 5 females, leg. Kolcsár L.-P.; same location, 20 July 2017, 1 male, leg. Keresztes L.; Voşlobeni, Giurgeu Mts., Súgó brook valley, 905 m, 46.665022° N, 25.652262° E, 8 July 2017, 1 female, leg. Keresztes L.; Cluj-Napoca, Alexandru Borza Botanical Garden (Malaise trap), 395 m, 46.761322° N, 23.586521° E, 20 July 2017, 1 female, leg. Kolcsár L.-P.; Doda Pili, Bihor Mts., Cheile Someşului Cald, 1200 m, 46.637443° N, 22.718924° E, 1 July 2016, 1 male, leg. Kolcsár L.-P., Török E.; Ciaracio, Ciuc Basin, Agris brook valley, 679 m, 46.412255° N, 25.739988° E, 10 August 2017, 1 female, leg. Ujvárosi B.

**Note 19:** Presence of *Cx. impudicus* in Romania is questionable. We did not find any reliably published record about the species in Romania and it has not been recorded in the neighboring countries either. However, the Online Catalog of Culicidae (Schaffner *et al.*, 2001) and MosKeyTool (Gunay *et al.*, 2017) list the species from Romania. Based on this remarks we include it in the present list.

**Note 20:** *Cx. mimeticus* occurs in Hungary (Tóth and Kenyeres 2012) and it is mentioned in the Online Catalog of Culicidae as member of the Romanian fauna, as well (Schaffner *et al.*, 2001). Based on former literature data (Sicart *et al.*, 1961, Motaş *et al.*, 1962, Nicolescu (1995) the potential presence of the species in Romania is acceptable.

**Note 21:** *Cx. pipiens* s.l. species group contains important vector species, which can transmit many zoonotic pathogens including human diseases. The complex consists of several species, subspecies, forms, races, physiological variants, or biotypes according to various authors (Farajollahi *et al.*, 2011). Up to the present, no taxonomic investigation on the *Cx. pipiens* complex from Romania has been initiated and further cryptic species may be expected. The subspecies *Cx. pipiens molestus* has no reliable faunistic data from the country.

**Material:** Valișoara, Trascău Mts., Valișoarei Cayon, 520 m, 46.384371° N, 23.575915° E, 14 November 2017, 1 female, leg. Kolcsár L.-P.; Doda Pili, Apuseni Mts., Firei valley, 1045 m, 46.664635° N, 22.8439377° E, 2 January 2018, 1 male, leg. Keresztes L.; Cluj-Napoca, Mikó garden, 337 m, 46.763588° N, 23.580218° E, 10 August 2015, 1 female, leg. Kolcsár L.-P.; Cluj-Napoca, Alexandru Borza Botanical Garden (Malaise trap), 395 m, 46.761322° N, 23.586521° E, 14 July 2015, 1 female, leg. Kolcsár L.-P.; same location, 22 May 2017, 1 female, leg. Kolcsár L.-P.; same location, 15 October 2015, 3 males, leg. Kolcsár L.-P.; same location, 2 November 2017, 2 males, leg. Kolcsár L.-P.; 26 September 2017, 1 male, 1 female, leg. Kolcsár L.-P.; Cluj-Napoca, Feleacu hills, Sáros-bükk marsh, 495 m, 46.69262° N, 23.55124° E, 15 April 2017, 1 female, leg. Keresztes L., Ujvárosi B.; Cluj-Napoca Sáros-bükk marsh, 459 m, 46.69262° N, 23.55124° E, 29 November 2017, 4 males, leg. Keresztes L., Ujvárosi B.; Voșlobeni, Giurgeu Basin, Senetea, 764 m, 46.625875° N, 25.597453° E, 16 July 2016, 1 female, leg. Kolcsár L.-P.; same location, 7 June 2017, 1 male, leg. Keresztes L.; same location, 20 July 2017, 4 males, 1 female, leg. Keresztes L.; Ciaracio, Ciuc Basin, Agris brook valley, 679 m, 46.412255° N, 25.739988° E, 10 August 2017, 3 females, leg. Ujvárosi B.; Breaza, Breaza forest, 392 m, 46.755395° N, 24.616005° E, 9 June 2017, 1 female, leg. Kolcsár L.-P., Török E.; Florești, Someșul Mic River, 354 m, 46.759912° N, 23.531731° E, 24 August 2017, 16 males, leg. Kolcsár L.-P.; Marghita, 135 m, 47.343892° N, 22.331358° E, 21 December 2017, 12 females, leg. Török E.; same location, 8 February 2018, 6 females, leg. Török E.; Gurghiu, dendrological park, 430 m, 46.773673° N, 24.861017° E, 5 July 2017, 9 females, leg. Ujvárosi B., Török E.; Marișel, Gilău Mts., Someșul Cald River, 577 m, 46.699827° N, 23.195381° E, 28 August 2016, 1 male, leg. Keresztes L.

**Note 22:** *Cx. torrentium* is a multivoltin species. It avoids feeding on humans, preferring birds instead (Becker *et al.*, 2010).

**Material:** Izvoru Mureșului, Giurgeu mts., Mureș River spring, 925 m, 46.633739° N, 25.67577° E, 16 July 2016, 2 males, leg. Kolcsár L.-P.; Gurghiu, dendrological park, 430 m, 46.773673° N, 24.861017° E, 5 July 2017, 1 male, leg. Ujvárosi B., Török E.; Voșlobeni, Giurgeu Basin, Senetea bog, 760 m, 46.625875° N, 25.597453° E, 16 July 2016, 1 male, leg. Kolcsár L.-P.

**Note 23:** *Cx. hortensis* feeds mostly on amphibians and reptiles, having numerous generations per year (Becker *et al.*, 2010).

Material: Vălișoara, Trascău Mts., Vălișoarei Cayon, 520 m, 46.384371° N, 23.575915° E, 14 November 2017, 1 male, leg. Kolcsár L.-P.; Breaza, Breaza forest, 392 m, 46.755395° N, 24.616005° E, 9 June 2017, 1 female, leg. Kolcsár L.-P., Török E.

**Note 24:** *Cs. annulata* has more than one generation per year. It is active all year round, and females are overwintering as imagoes. We found the species on walls inside of buildings and caves during winter.

Material: Cluj-Napoca, Alexandru Borza Botanical Garden (Malaise trap), 395 m, 46.761322° N, 23.586521° E, 26 February 2017, 1 male, leg. Kolcsár L.-P.; Breaza, Breaza forest, 392 m, 46.755395° N, 24.616005° E, 9 June 2017, 1 female, leg. Kolcsár L.-P., Török E.; Cluj-Napoca, Mikó garden, 337 m, 46.763588° N, 23.580218° E, 20 July 2016, 1 female, leg. Török E.; same location, 26 November 2017, 1 female, leg. Török E.; Vălișoara, Trascău Mts., Vălișoarei Cayon, 520 m, 46.384371° N, 23.575915° E, 14 November 2017, 2 females, leg. Kolcsár L.-P.; Crestur, 160 m, 47.346511° N, 22.239962° E, 20 July 2017, 7 females, leg. Török E.

**Note 25:** *Cs. glaphyoptera* is a cold relict species. It lives in forest habitats. The species feeding preferences are related to different species of birds (Hubalek, 2008, Becker *et al.*, 2010).

Material: Hagota, Giurgeu Mts., Tisasul valley, 860 m, 46.861794° N, 25.677228° E, 11 February 2016, 2 males, leg. Kolcsár L.-P.; Ciaracio, Ciuc Basin, Agris brook valley, 679 m, 46.412255° N, 25.739988° E, 10 August 2017, 1 female, leg. Ujvárosi B.

## Conclusions

The first checklist of the Culicidae fauna of Romania was published in 1995 by Nicolescu. He presented 50 Culicidae. In the present study, we updated this checklist and increased the number of species to 60. Our faunistic results of the last few years focused mainly on some less studied areas in Romania such as Transylvania, from where new faunistic data on 20 different Culicidae species were recorded.

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