

FAUNA AQUATICA AUSTRIACA

DIPTERA: CULICIDAE (Mosquitoes)

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The European mosquito fauna comprises roughly 100 species. Since the last issue of the *Fauna Aquatica Austriaca* (2002), the Austrian mosquito species inventory increased from 39 species to 49 species, totalling 50 discernible taxa. The main reason for this increase in species numbers is the concentrated effort of different working groups, particularly in eastern Austria. Recent reports contribute *Aedes geminus*, *Aedes diaantaeus* and *Culiseta ochroptera* from the bogs around Schrems (Lechthaler, 2005), *Aedes cyprius*, *Aedes riparius* and *Aedes nigrinus* from the Danube and March floodplains (Jerrentrup et al. 2015, Seidel 2011), *Culiseta longiareolata* from the Danube floodplains, Carinthia and Styria (Zittra et al., 2015, Seidel et al., 2013) and *Anopheles hyrcanus* from the Neusiedler See (Lebl et al. 2013). While the majority of those species belong to the Central to Northern European fauna, *Anopheles hyrcanus* and *Culiseta longiareolata* are considered to be Mediterranean faunal elements. Likewise, the most recent addition to the Austrian mosquito inventory, *Orthopodomyia pulcripalpis* (Zittra et al. 2017a), is a typical south European species and is characterized as holomediterranean element of the Arboreal (Aspöck, 2008; Zittra et al., 2017a). Larvae of this species develop in tree holes (dendrotelmata), like those of *Aedes geniculatus* and *Anopheles plumbeus*.

Furthermore, two non-native mosquito species, *Aedes japonicus* and *Aedes albopictus* were confirmed in Austria. *Aedes albopictus* originates from Southeast Asia and had possibly been introduced to the western Palaearctic region by global trade with used car tyres (Reiter, 1998). Today, this species is distributed in many countries of North America and Europe, but it is considered as thermophilic and cannot persist for longer periods of frost, even not in the egg stage (Nawrocki & Hawley, 1987; Mitchell, 1995; Kobayashi et al., 2002), which results in a limited distribution in the Mediterranean. The nearest established population of *Aedes albopictus* to Austria is located in Bozen, Southern Tyrol, Italy, where the species is spreading since its first observation in 2010 (Sonnleitner et al. 2013). In Austria, the occurrence of *Aedes albopictus* is restricted to single findings along transit routes. This species is considered not to be established in Austria so far and is therefore not included in the FAA species list.

The geographical expansion of *Aedes japonicus*, originating from the East Asian region (Tanaka et al., 1979), has been facilitated by human activities like global trade with used tyres and tropical plants (Becker et al., 2011; Peyton et al., 1999; Schaffner et al., 2003). In contrast to *Aedes albopictus* it is adapted to winter temperatures in temperate climates with snowy winters and it can also be found in higher altitudes (Tanaka et al., 1979). Moreover, recent studies indicate a successive spread from western to middle Europe (Becker et al. 2011, Schneider 2011). In Austria *Aedes japonicus* has been confirmed in several provinces (Zittra et al., 2017b).

Additionally, the members of the *Culex pipiens* complex were quantified and qualified for the first time in Austria using molecular methods (Zittra et al. 2016). Although morphologically hardly distinguishable, the differentiation of these taxa is highly relevant due of their different epidemiological importance. In Austria, this species complex consists of two taxa, *Cx. pipiens f. pipiens* and *Cx. pipiens f. molestus*. The former taxon is described as ornithophilic, diapausing, anautogenous, and eurygamous, whereas the latter taxon is described as mammophilic (and especially anthropophilic), non-diapausing, autogenous, and stenogamous (Becker et al. 2012, Weyer 1936). Furthermore, hybrids of both taxa, which can possibly act as bridge vectors – e.g. between humans and birds – where also found in Austria. Both ecoforms are listed as independent taxa in the FAA.

Mosquito larvae are negligible indicators for traditional water quality assessments that focus on organic pollution. Due to their ability of breathing atmospheric oxygen, the larval and pupal stages are not affected by oxygen-consuming processes in the aquatic environment. Yet, mosquito larvae

are active filter feeders that need higher concentrations of suspended organic particles and thus generally indicate nutrient-rich waters with a high organic or trophic load.

Regarding the longitudinal zonation, the aquatic stages of mosquitoes are strongly associated with lentic conditions and are exclusively found in the littoral of standing and slowly flowing waters. As many species are adapted to develop in temporary, semi-permanent or perennial waterbodies, depending on egg-laying strategies and life cycles, the composition of species communities may offer information about the hydraulic conditions in the breeding sites. This makes mosquitoes a useful indicator group for the classification of stagnant waters (e.g. in floodplain areas).

Mosquitoes are of significant interest because of their ability to transmit several pathogens such as Malaria, Yellow- or Dengue fever, all of which can have a severe impact on human health. The introduction of mosquitoes outside their native range due to global trade, e.g., of lucky bamboo (*Dracaena* sp.) or used tyres (both important trading goods), transcontinental movement of humans and pets and also shifts in mosquito species community composition possibly result in an increased transmission risk. Nevertheless, also native mosquito species are able to transmit several pathogens to humans, pets and livestock and should consequently be focused on limnological studies.

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Species inventory

Genus *Aedes* MEIGEN, 1818

Subgenus *Aedes*

Aedes (Aedes) cinereus MEIGEN, 1818

Aedes (Aedes) geminus PEUS, 1970

Aedes (Aedes) rossicus DOLBENSKIN, GORICKAY & MITROFANOVA, 1930

Subgenus *Aedimorphus*

Aedes (Aedimorphus) vexans (MEIGEN, 1830)

Subgenus *Finlaya*

Aedes (Finlaya) geniculatus (OLIVIER, 1791)

Subgenus *Hulecoeteomyia*

Aedes (Hulecoeteomyia) japonicus (THEOBALD, 1901)

Subgenus *Ochlerotatus*

Aedes (Ochlerotatus) annulipes (MEIGEN, 1830)

Aedes (Ochlerotatus) cantans (MEIGEN, 1818)

Aedes (Ochlerotatus) caspius (PALLAS, 1771)

Aedes (Ochlerotatus) cataphylla DYAR, 1916

Aedes (Ochlerotatus) communis (DE GEER, 1776)

Aedes (Ochlerotatus) cyprius LUDLOW 1919

Aedes (Ochlerotatus) detritus (HALIDAY, 1833)

Aedes (Ochlerotatus) diantaeus (HOWARD, DYAR & KNAB, 1912)

Aedes (Ochlerotatus) dorsalis (MEIGEN, 1830)

Aedes (Ochlerotatus) excrucians (WALKER, 1856)

Aedes (Ochlerotatus) flavescens (MÜLLER, 1764)

Aedes (Ochlerotatus) hungaricus MILHALYI, 1955

Aedes (Ochlerotatus) intrudens DYAR, 1919

Aedes (Ochlerotatus) leucomelas (MEIGEN, 1804)

Aedes (Ochlerotatus) nigrinus (ECKSTEIN, 1918)

Aedes (Ochlerotatus) pullatus (COQUILLET, 1904)

Aedes (Ochlerotatus) punctor (KIRBY, 1837)

Aedes (Ochlerotatus) riparius DYAR & KNAB 1907

Aedes (Ochlerotatus) rusticus (ROSSI, 1790)

Aedes (Ochlerotatus) sticticus (MEIGEN, 1838)

Genus *Anopheles* MEIGEN, 1818

Subgenus *Anopheles*

Anopheles (Anopheles) algeriensis THEOBALD, 1903

Anopheles (Anopheles) atroparvus VAN THIEL, 1927

Anopheles (Anopheles) claviger (MEIGEN, 1804)

Anopheles (Anopheles) hyrcanus (PALLAS, 1771)

Anopheles (Anopheles) maculipennis MEIGEN, 1818

Anopheles (Anopheles) messae FALLERONI, 1926

Anopheles (Anopheles) plumbeus STEPHENS, 1928

Genus Coquillettidia DYAR, 1905**Subgenus Coquillettidia**

Coquillettidia (Coquillettidia) richiardii (FICALBI, 1889)

Genus Culex LINNAEUS, 1758**Subgenus Barraudius**

Culex (Barraudius) modestus FICALBI, 1889

Subgenus Culex

Culex (Culex) pipiens f. molestus LINNAEUS, 1758

Culex (Culex) pipiens f. pipiens LINNAEUS, 1758

Culex (Culex) torrentium MARTINI, 1925

Subgenus Neoculex

Culex (Neoculex) hortensis FICALBI, 1889

Culex (Neoculex) martinii MEDSCHID, 1930

Culex (Neoculex) territans WALKER, 1856

Genus Culiseta FELT, 1904**Subgenus Allotheobaldia**

Culiseta (Allotheobaldia) longiareolata (MACQUART, 1838)

Subgenus Culicella

Culiseta (Culicella) morsitans (THEOBALD, 1901)

Subgenus Culiseta

Culiseta (Culiseta) alaskaensis (LUDLOW, 1906)

Culiseta (Culiseta) annulata (SCHRANK, 1776)

Culiseta (Culiseta) glaphyroptera (SCHINER, 1864)

Culiseta (Culiseta) ochroptera (PEUS, 1935)

Culiseta (Culiseta) subochrea (EDWARDS, 1921)

Genus Orthopodomyia THEOBALD, 1904

Orthopodomyia pulcripalpis (RONDANI, 1872)

Genus Uranotaenia LYNCH & ARRIBALZAGA, 1891**Subgenus Pseudoficalbia**

Uranotaenia (Pseudoficalbia) unguiculata EDWARDS, 1913

	Longitudinal distribution									
	EUC	HYC	ER	MR	HR	EP	MP	HP	LIT	PRO
Aedes										
Untergattung Aedes										
<i>Aedes (Aedes) cinereus</i>	-	-	-	-	-	-	-	-	10	-
<i>Aedes (Aedes) geminus</i>	-	-	-	-	-	-	-	-	10	-
<i>Aedes (Aedes) rossicus</i>	-	-	-	-	-	-	-	-	10	-
Untergattung Aedimorphus										
<i>Aedes (Aedimorphus) vexans</i>	-	-	-	-	-	-	-	-	10	-
Untergattung Finlaya										
<i>Aedes (Finlaya) geniculatus</i>	-	-	-	-	-	-	-	-	-	-
		dendrotelms								
Untergattung Hulecoeteomyia										
<i>Aedes (Hulecoeteomyia) japonicus</i>	-	-	-	-	-	-	-	-	10	-
Untergattung Ochlerotatus										
<i>Aedes (Ochlerotatus) annulipes</i>	-	-	-	-	-	-	-	-	10	-
<i>Aedes (Ochlerotatus) cantans</i>	-	-	-	-	-	-	-	-	10	-
<i>Aedes (Ochlerotatus) caspius</i>	-	-	-	-	-	-	-	-	10	-
<i>Aedes (Ochlerotatus) cataphylla</i>	-	-	-	-	-	-	-	-	10	-
<i>Aedes (Ochlerotatus) communis</i>	-	-	-	-	-	-	-	-	10	-
<i>Aedes (Ochlerotatus) cyprius</i>	-	-	-	-	-	-	-	-	-	-
<i>Aedes (Ochlerotatus) detritus</i>	-	-	-	-	-	-	-	-	10	-
<i>Aedes (Ochlerotatus) diantaeus</i>	-	-	-	-	-	-	-	-	10	-
<i>Aedes (Ochlerotatus) dorsalis</i>	-	-	-	-	-	-	-	-	10	-
<i>Aedes (Ochlerotatus) excrucians</i>	-	-	-	-	-	-	-	-	10	-
<i>Aedes (Ochlerotatus) flavescens</i>	-	-	-	-	-	-	-	-	10	-
<i>Aedes (Ochlerotatus) hungaricus</i>	-	-	-	-	-	-	-	-	10	-
<i>Aedes (Ochlerotatus) intrudens</i>	-	-	-	-	-	-	-	-	10	-
<i>Aedes (Ochlerotatus) leucomelas</i>	-	-	-	-	-	-	-	-	10	-
<i>Aedes (Ochlerotatus) nigrinus</i>	-	-	-	-	-	-	-	-	10	-
<i>Aedes (Ochlerotatus) pullatus</i>	-	-	-	-	-	-	-	-	10	-
<i>Aedes (Ochlerotatus) punctor</i>	-	-	-	-	-	-	-	-	10	-
<i>Aedes (Ochlerotatus) riparius</i>	-	-	-	-	-	-	-	-	-	-
<i>Aedes (Ochlerotatus) rusticus</i>	-	-	-	-	-	-	-	-	10	-

	EUC	HYC	ER	MR	HR	EP	MP	HP	LIT	PRO
<i>Aedes (Ochlerotatus)</i>	-	-	-	-	-	-	-	-	10	-
<i>sticticus</i>										
Anopheles										
Untergattung Anopheles										
<i>Anopheles (Anopheles)</i>	-	-	-	-	-	-	-	-	10	-
<i>algeriensis</i>										
<i>Anopheles (Anopheles)</i>	-	-	-	-	-	-	-	-	10	-
<i>atroparvus</i>										
<i>Anopheles (Anopheles)</i>	-	-	-	-	-	-	+	-	10	-
<i>claviger</i>										
<i>Anopheles (Anopheles)</i>	-	-	-	-	-	-	-	-	10	-
<i>hyrcanus</i>										
<i>Anopheles (Anopheles)</i>	-	-	-	-	-	-	-	-	10	-
<i>maculipennis</i>										
<i>Anopheles (Anopheles)</i>	-	-	-	-	-	-	-	-	10	-
<i>messae</i>										
<i>Anopheles (Anopheles)</i>	-	-	-	-	-	-	-	-	-	-
<i>plumbeus</i>										
		dendrotelms								
Coquillettidia										
Untergattung Coquillettidia										
<i>Coquillettidia</i>	-	-	-	-	-	-	-	-	10	-
<i>(Coquillettidia) richiardii</i>										
Culex										
Untergattung Barraudius										
<i>Culex (Barraudius) modestus</i>	-	-	-	-	-	-	-	-	10	-
Untergattung Culex										
<i>Culex (Culex) pipiens f.</i>	-	-	-	-	-	-	-	-	10	-
<i>molestus</i>										
<i>Culex (Culex) pipiens f.</i>	-	-	-	-	-	-	+	-	10	-
<i>pipiens</i>										
		dendrotelms								
<i>Culex (Culex) torrentium</i>	-	-	-	-	-	-	+	-	10	-
		dendrotelms								
Untergattung Neoculex										
<i>Culex (Neoculex) hortensis</i>	-	-	-	-	-	-	-	-	10	-
<i>Culex (Neoculex) martinii</i>	-	-	-	-	-	-	-	-	10	-
<i>Culex (Neoculex) territans</i>	-	-	-	-	-	-	+	-	10	-
Culiseta										
Untergattung Allotheobaldia										
<i>Culiseta (Allotheobaldia)</i>	-	-	-	-	-	-	-	-	10	-
<i>longiareolata</i>										
Untergattung Culicella										
<i>Culiseta (Culicella)</i>	-	-	-	-	-	-	-	-	10	-
<i>morsitans</i>										
Untergattung Culiseta										
<i>Culiseta (Culiseta)</i>	-	-	-	-	-	-	-	-	10	-
<i>alaskaensis</i>										

	EUC	HYC	ER	MR	HR	EP	MP	HP	LIT	PRO
<i>Culiseta (Culiseta) annulata</i>	-	-	-	-	-	-	+	-	10	-
<i>Culiseta (Culiseta)</i> <i>glaphyoptera</i>	-	-	-	-	-	-	-	-	10	-
<i>Culiseta (Culiseta)</i> <i>ochroptera</i>	-	-	-	-	-	-	-	-	10	-
<i>Culiseta (Culiseta)</i> <i>subochrea</i>	-	-	-	-	-	-	-	-	10	-
Orthopodomyia										
<i>Orthopodomyia pulcripalpis</i>	-	-	-	-	-	-	-	-	-	-
		dendrotelms								
Uranotaenia										
Untergattung Pseudoficalbia										
<i>Uranotaenia</i> <i>(Pseudoficalbia) unguiculata</i>	-	-	-	-	-	-	-	-	10	-

Functional feeding guilds										
	SHR	GRA	AFIL	PFIL	DET	MIN	XYL	PRE	PAR	OTH
Aedes										
Untergattung Aedes										
<i>Aedes (Aedes) cinereus</i>	-	1	8	-	1	-	-	-	-	-
<i>Aedes (Aedes) geminus</i>	-	1	8	-	1	-	-	-	-	-
<i>Aedes (Aedes) rossicus</i>	-	1	8	-	1	-	-	-	-	-
Untergattung Aedimorphus										
<i>Aedes (Aedimorphus) vexans</i>	-	1	8	-	1	-	-	-	-	-
Untergattung Finlaya										
<i>Aedes (Finlaya) geniculatus</i>	-	1	8	-	1	-	-	-	-	-
Untergattung Hulecoeteomyia										
<i>Aedes (Hulecoeteomyia) japonicus</i>	-	1	8	-	1	-	-	-	-	-
Untergattung Ochlerotatus										
<i>Aedes (Ochlerotatus) annulipes</i>	-	1	8	-	1	-	-	-	-	-
<i>Aedes (Ochlerotatus) cantans</i>	-	1	8	-	1	-	-	-	-	-
<i>Aedes (Ochlerotatus) caspius</i>	-	1	8	-	1	-	-	-	-	-
<i>Aedes (Ochlerotatus) cataphylla</i>	-	1	8	-	1	-	-	-	-	-
<i>Aedes (Ochlerotatus) communis</i>	-	1	8	-	1	-	-	-	-	-
<i>Aedes (Ochlerotatus) cyprius</i>	-	1	8	-	1	-	-	-	-	-
<i>Aedes (Ochlerotatus) detritus</i>	-	1	8	-	1	-	-	-	-	-
<i>Aedes (Ochlerotatus) diantaeus</i>	-	1	8	-	1	-	-	-	-	-
<i>Aedes (Ochlerotatus) dorsalis</i>	-	1	8	-	1	-	-	-	-	-
<i>Aedes (Ochlerotatus) excrucians</i>	-	1	8	-	1	-	-	-	-	-
<i>Aedes (Ochlerotatus) flavescens</i>	-	1	8	-	1	-	-	-	-	-
<i>Aedes (Ochlerotatus) hungaricus</i>	-	1	8	-	1	-	-	-	-	-
<i>Aedes (Ochlerotatus) intrudens</i>	-	1	8	-	1	-	-	-	-	-
<i>Aedes (Ochlerotatus) leucomelas</i>	-	1	8	-	1	-	-	-	-	-
<i>Aedes (Ochlerotatus) nigrinus</i>	-	1	8	-	1	-	-	-	-	-
<i>Aedes (Ochlerotatus) pullatus</i>	-	1	8	-	1	-	-	-	-	-
<i>Aedes (Ochlerotatus) punctor</i>	-	1	8	-	1	-	-	-	-	-
<i>Aedes (Ochlerotatus) riparius</i>	-	1	8	-	1	-	-	-	-	-
<i>Aedes (Ochlerotatus) rusticus</i>	-	1	8	-	1	-	-	-	-	-

	SHR	GRA	AFIL	PFIL	DET	MIN	XYL	PRE	PAR	OTH
<i>Aedes (Ochlerotatus) sticticus</i>	-	1	8	-	1	-	-	-	-	-
Anopheles										
Untergattung Anopheles										
<i>Anopheles (Anopheles) algeriensis</i>	-	5	5	-	-	-	-	-	-	-
<i>Anopheles (Anopheles) atroparvus</i>	-	5	5	-	-	-	-	-	-	-
<i>Anopheles (Anopheles) claviger</i>	-	5	5	-	-	-	-	-	-	-
<i>Anopheles (Anopheles) hyrcanus</i>	-	5	5	-	-	-	-	-	-	-
<i>Anopheles (Anopheles) maculipennis</i>	-	5	5	-	-	-	-	-	-	-
<i>Anopheles (Anopheles) messae</i>	-	5	5	-	-	-	-	-	-	-
<i>Anopheles (Anopheles) plumbeus</i>	-	5	5	-	-	-	-	-	-	-
Coquillettidia										
Untergattung Coquillettidia										
<i>Coquillettidia (Coquillettidia) richiardii</i>	-	-	10	-	-	-	-	-	-	-
Culex										
Untergattung Barraudius										
<i>Culex (Barraudius) modestus</i>	-	-	10	-	-	-	-	-	-	-
Untergattung Culex										
<i>Culex (Culex) pipiens f. molestus</i>	-	-	10	-	-	-	-	-	-	-
<i>Culex (Culex) pipiens f. pipiens</i>	-	-	10	-	-	-	-	-	-	-
<i>Culex (Culex) torrentium</i>	-	-	10	-	-	-	-	-	-	-
Untergattung Neoculex										
<i>Culex (Neoculex) hortensis</i>	-	-	10	-	-	-	-	-	-	-
<i>Culex (Neoculex) martinii</i>	-	-	10	-	-	-	-	-	-	-
<i>Culex (Neoculex) territans</i>	-	-	10	-	-	-	-	-	-	-
Culiseta										
Untergattung Allotheobaldia										
<i>Culiseta (Allotheobaldia) longiareolata</i>	-	2	8	-	-	-	-	-	-	-
										also predacious behaviour
Untergattung Culicella										
<i>Culiseta (Culicella) morsitans</i>	-	-	10	-	-	-	-	-	-	-
Untergattung Culiseta										
<i>Culiseta (Culiseta) alaskaensis</i>	-	2	8	-	-	-	-	-	-	-
<i>Culiseta (Culiseta) annulata</i>	-	2	8	-	-	-	-	-	-	-

	SHR	GRA	AFIL	PFIL	DET	MIN	XYL	PRE	PAR	OTH
<i>Culiseta (Culiseta)</i> <i>glaphyoptera</i>	-	2	8	-	-	-	-	-	-	-
<i>Culiseta (Culiseta)</i> <i>ochroptera</i>	-	-	10	-	-	-	-	-	-	-
<i>Culiseta (Culiseta)</i> <i>subochrea</i>	-	2	8	-	-	-	-	-	-	-
Orthopodomyia										
<i>Orthopodomyia pulcripalpis</i>	-	-	-	-	-	-	-	-	-	-
Uranotaenia										
Untergattung Pseudoficalbia										
<i>Uranotaenia</i> <i>(Pseudoficalbia) unguiculata</i>	-	2	8	-	-	-	-	-	-	-