

**Preliminary studies on the mosquito fauna of Luxembourg**

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**Abstract**

From May through August 2001 mosquito collections were conducted at twelve different sites in Luxembourg using CO<sub>2</sub>-traps, human-bait collections and larval dipping. In total, fifteen mosquito species were recorded, with *Culex pipiens* exhibiting the widest distribution.

**Introduction**

Snow & Ramsdale (1999) published a checklist of the mosquito fauna of thirty-eight European countries and five isolated European islands to form the basis of an agreed listing for future work on the taxonomy and distribution of European mosquitoes. Surprisingly it was established that Luxembourg (Grand-Duché de Luxembourg) was the only European country without records of mosquito species.

Since Luxembourg is adjacent to Germany and does not have resident mosquito researchers, the authors decided to start a survey on the mosquito fauna of Luxembourg in 2001 in order to contribute to the checklist of European mosquitoes.

**Study area**

Luxembourg is a small Central European country covering an area of 2,586 km<sup>2</sup>. The country is populated by some 429,200 citizens and is bordered by France (south), Belgium (west) and Germany (east). Topographically it is a hilly country with elevations between 130 and 559 m above sea level. The landscape is characterised by agriculture and deciduous beech (*Fagus sylvatica*) forest. Four major rivers traverse the country: the Moselle, Sûre, Our and Alzette.

The climate of Luxembourg is temperate. The relative proximity of the Atlantic Ocean (about 320 km), and the modifying influence of the Gulf Stream provide mean temperatures between 0.7°C (in January) and 17.3°C (in July). The mean annual rainfall is 782.2 mm.

The geology of Luxembourg is dominated by Jurassic and Triassic sediments, except for the Ardennes in the north where Devonian slate predominates. Alluvial sediments are found only along the River Moselle.

**Study method**

Initially eight promising sites scattered throughout the country were chosen for routine sampling at monthly intervals from May to August 2001, using CO<sub>2</sub>-trapping, human bait catches and dipping in adjacent larval sites as sampling methods. Two more sites (numbers 4 and 8) were added in July and another two sites (numbers 2 and 5) in August (Table 1, Figure 1) and subjected to the same sampling routine as the original sites from then on. The exact locations of the sampling sites were determined using a handheld GPS-device (Garmin 12 CX) resulting in the co-ordinates shown in Table 1.

Specimens were determined morphologically as far as possible using the keys of Mohrig (1969) and Becker *et al.* (2003). Specimens of *Culex pipiens/torrentium* were subjected to enzyme electrophoresis in 1% horizontal agarose gels for further determination. Substrate-specific staining for adenylate kinase (AK, E.C. 2.7.4.3) allowed discrimination of these species (Weitzel *et al.*, 2001).

**Results and discussion**

Using the three techniques described, 203 mosquito specimens were examined, belonging to 15 species. CO<sub>2</sub> trapping resulted in the capture of 43 adults, human bait collections of 59 adults and dipping of 101 larvae. The occurrence of mosquito species according to sampling site and sampling technique is depicted in Table 2.

The species exhibiting the widest distribution was *Culex pipiens*, which occurred at six sites. This was followed by three *Anopheles* species (*An. plumbeus*: 5 sites; *An. claviger* and *An. maculipennis s.l.*: 4 sites each). *Ochlerotatus cantans* occurred at two sites. Each of the other mosquito species was found at single sites only. No mosquitoes were found at one site (Clervaux).

The sites with the greatest species diversity were sites 8 (Dondelange; 8 species), 1 (Schengen; 5 species) and 5 (Berg; 4 species). The highest numbers of temporary surface water breeding *Aedes/Ochlerotatus* species were observed at site 1 (Schengen) and of species breeding in permanent surface waters or artificial containers at site 3 (Bous).

Species composition of collections differed considerably according to the particular characteristics of each site. Thus floodwater species of the genera *Aedes* and *Ochlerotatus* were found only at Berg, Schengen and Grengewald. All mosquito specimens collected at site 8 (Dondelange) were taken from artificial sites, including discarded tyres. Specimens of *Coquillettidia*, the aquatic stages of which attach themselves to the submerged roots and stalks of emergent vegetation, were found only in the swampy area of site 2 (Haff Remich).

*Culex pipiens*, *An. plumbeus*, *An. claviger* and *An. maculipennis s.l.* were the most frequently encountered species throughout the country.

Altogether 19 adults and 13 larvae of *Culex pipiens/torrentium* were investigated by means of enzyme electrophoresis. Of the adults investigated, 18 showed the characteristic AK banding pattern of *Cx. pipiens*. Only one specimen showed intermediate characters, i.e. heterozygosity with allozymes belonging to *Cx. pipiens* and *Cx. torrentium*, respectively.

This rare effect (<1%) was checked for other *Culex* populations, where heterozygous specimens were confirmed as *Cx. torrentium*. Therefore this adult was considered to belong to *Cx. torrentium* with a probability of 90%. In contrast, eleven of the 13 larvae were found to be *Cx. torrentium* and only two *Cx. pipiens*, proving the occurrence of both species in Luxembourg.

## Conclusion

Though our survey showed the mosquito fauna of Luxembourg to be quite rich, nowhere did they occur in large numbers or cause a nuisance.

Due to the geology of the country, it is rare for surface water to provide favourable breeding sites for mosquitoes. Therefore the occurrence of mosquitoes is restricted to the following habitats:

- areas along rivers or creeks which are flooded in intervals, providing breeding habitats for floodwater mosquitoes (*Aedes* and *Ochlerotatus*)
- shallow, still or slowly running water bodies with dense plant cover, providing breeding habitats for *Anopheles* mosquitoes
- swampy and permanently flooded areas can provide breeding habitats for *Coquillettidia richiardii* (rare and restricted to larger rivers)
- artificial breeding sites, like rainwater containers and used tyres, in which *Anopheles* and *Culex* larvae were also found, were the most productive type of larval site encountered.

## References

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Figure 1. Map of Luxembourg showing the locations of the sampling sites

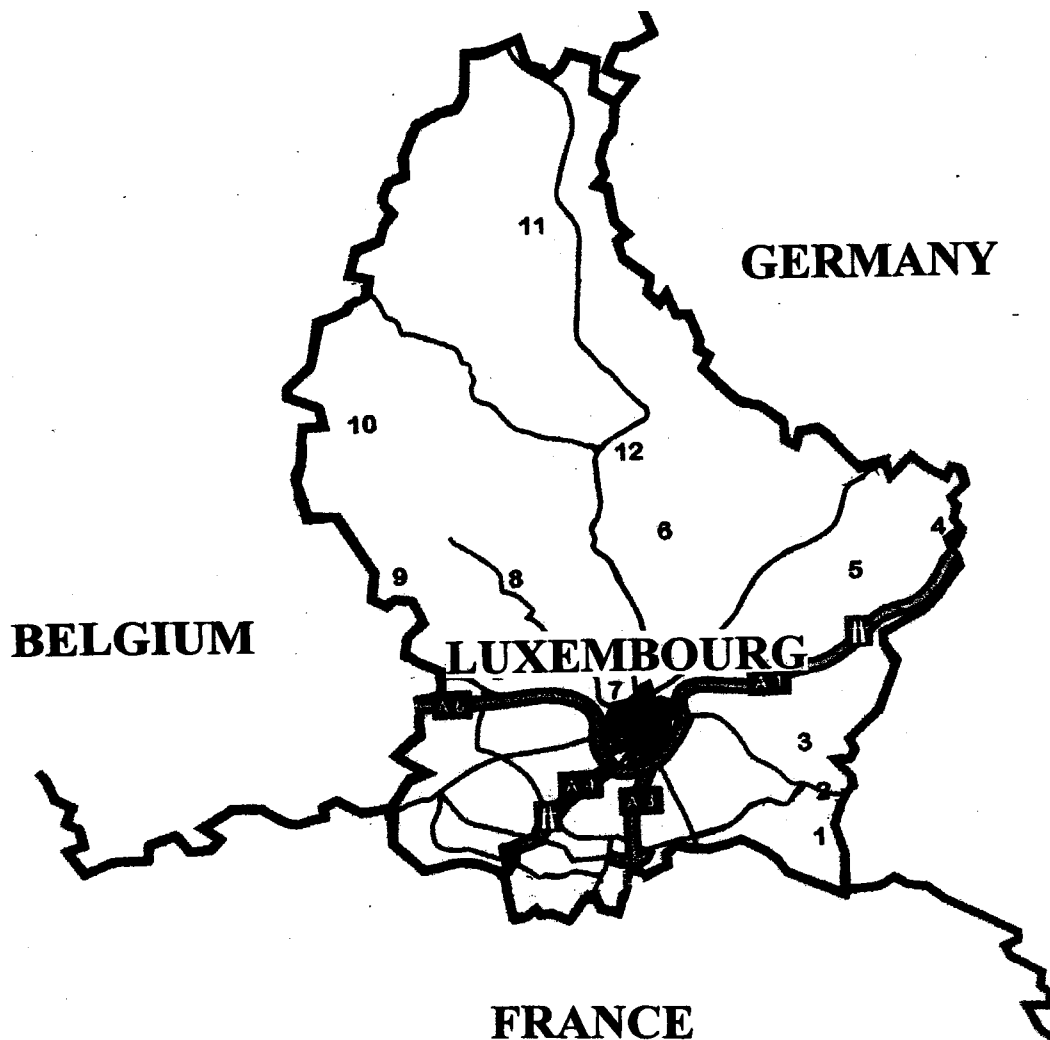


Table 1. Details of the sampling sites

No.	Location	Description	longitude (°N)	latitude (°E)	altitude [m]
1	Schengen	floodplain along river Moselle	49° 29.358'	6° 22.110'	159
2	Haff Remich	swampy area (protected)	49° 29.865'	6° 21.950'	159
3	Bous	gardens	49° 33.435'	6° 19.809'	172
4	Wasserbillig	riverine habitat	49° 43.503'	6° 30.526'	150
5	Berg	floodplain along small river	49° 41.214'	6° 22.544'	238
6	Grengewald	forest with small creek	49° 40.402'	6° 10.772'	352
7	Luxembourg	forest close to settlement	49° 37.808'	6° 06.815'	284
8	Dondelange	riverine, with tyre dump nearby	49° 41.870'	6° 02.009'	255
9	Neimillen	riverine, meadows along forest	49° 40.753'	5° 56.143'	292
10	Pont de Misère	close to nearly stagnant river Sûre	49° 52.360'	5° 50.197'	329
11	Clervaux	forest high above river	50° 02.875'	6° 01.112'	342
12	Ingeldorf	riverine, floodplain meadows	49° 51.114'	6° 07.975'	204

Table 2. List of mosquito species found in Luxembourg

"X" represents the presence of the species

Species	Method		Site											
	Adults / Larvae	Human Bait / Trap	Schengen	Haff Remich	Bous	Wasserbilling	Berg	Grengewald	Luxembourg	Dondelange	Neimillen	Pont de	Clervaux	Ingeldorf
			1	2	3	4	5	6	7	8	9	10	11	12
<i>Anopheles claviger</i> Meigen, 1804	L									X				
	A	T HB					X			X				
<i>Anopheles maculipennis</i> s.l. Meigen, 1818	L		X	X						X		X		
	A	T HB	X	X								X		
<i>Anopheles plumbeus</i> Stephens, 1828	L													
	A	T HB		X		X	X	X	X					
<i>Aedes cinereus</i> Meigen, 1818	L													
	A	T HB	X											
<i>Ochlerotatus annulipes</i> Meigen, 1830	L													
	A	T HB	X	X										
<i>Ochlerotatus cantans</i> Meigen, 1818	L													
	A	T HB	X			X								
<i>Ochlerotatus geniculatus</i> Olivier, 1791	L									X				
	A	T HB												
<i>Ochlerotatus punctor</i> Kirby, 1837	L													
	A	T HB						X						
<i>Ochlerotatus rusticus</i> Rossi, 1790	L													
	A	T HB	X	X										
<i>Ochlerotatus sticticus</i> Meigen, 1838	L													
	A	T HB				X		X						
<i>Culex pipiens</i> Linnaeus, 1758	L									X				
	A	T HB		X	X			X	X		X		X	
<i>Culex territans</i> Walker, 1856	L									X				
	A	T HB												
<i>Culex torrentium</i> Martini, 1924	L									X				
	A	T HB		X										
<i>Culiseta annulata</i> Schrank, 1776	L									X				
	A	T HB												
<i>Coquillettidia richiardii</i> Ficalbi, 1889	L													
	A	T HB	X											