

Update on the distribution of some mosquito (Diptera: Culicidae) species in Portugal

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Abstract

The distribution of certain mosquito species in continental Portugal, namely *Anopheles plumbeus* Stephens, 1828, *Ochlerotatus berlandi* (Séguy, 1921), *Coquillettidia richiardii* (Ficalbi, 1889), *Culex laticinctus* Edwards, 1913 and *Uranotaenia unguiculata* Edwards, 1913, which previously had been recorded with either limited distribution or sporadic occurrence, is updated on the basis of findings in districts other than those in which they were previously recorded.

Introduction

The study of mosquitoes (Diptera: Culicidae) from Portugal was started by Sarmiento & França in 1901 and Jorge & Sarmiento in 1906 (Ribeiro *et al.*, 1988). However, it was some twenty-five years later that 21 species were listed in a comprehensive monograph (Braga, 1931). Research on Portuguese mosquitoes was continued with, among others, the works of Cambournac (1938, 1943, 1976) which were reviewed by Ribeiro *et al.* (1988). Between 1977 and 1988 the culicid fauna of Portugal was systematically studied by Ribeiro and co-workers (Capela *et al.*, 1983; Pires *et al.*, 1982; Ramos, 1983-84; Ramos *et al.*, 1977-78, 1982; Ribeiro *et al.*, 1977, 1977-78, 1980, 1983, 1985a, 1985b). An annotated checklist of the mosquitoes of continental Portugal finally summed up these works as 40 species, of which 10 were anophelines and 30 culicines (Ribeiro *et al.*, 1988). However, some of the species therein referred to have a limited distribution or are sporadic (Snow & Ramsdale, 1999).

Such is the case of *Coquillettidia* (*Coquillettidia*) *richiardii* (Ficalbi, 1889), which was recorded in 1926 in just one locality in the north of the country in the district of Guarda (Braga, 1931). One specimen of this species was later collected in the centre of the city of Lisbon, as an unpublished record by Barros Machado (Ribeiro *et al.*, 1988), and another specimen, a female, also unpublished, was collected in 1976 in the district of Setúbal, centre south of the country, by a group of students during a field trip (Fig. 1). Therefore, this species was very scantily represented in Portugal.

Anopheles (*Anopheles*) *plumbeus* Stephens, 1828, a tree hole breeding mosquito, was likewise first recorded by Braga (1931) in the central north of the country, district of Guarda, and later its presence was recorded in the north in the districts of Braga¹ and Aveiro, and in the central south, Setúbal district (Ramos, 1983-84).

Ochlerotatus (*Ochlerotatus*) *berlandi* (Séguy, 1921) was first recorded in 1977 from several localities in the centre, districts of Castelo Branco, Portalegre, Lisboa and Setúbal (Ribeiro *et al.*, 1977) and later its presence was confirmed in these districts (Ramos, 1983-84). Its distribution was widened to the southern district of Beja during collections in 1991-2 (Novo & Ramos, unpublished records).

Culex (*Culex*) *laticinctus* Edwards, 1913, was recorded in the north, Braga and Porto districts (Braga, 1931) and in the southernmost district, Faro, of the Algarve (Ramos *et al.*, 1977-78; Ramos *et al.*, 1992), and has not been recorded between these two geographic extremes.

Uranotaenia (*Pseudoficalbia*) *unguiculata* Edwards, 1913, was recorded in Portugal for the first time in the southern district of Beja, one male from a pupa (Ribeiro *et al.*, 1977-78), and two additional male specimens were recorded in 1991, also in the south of the country close to the border with Spain, in the districts of Beja and Faro (Ramos *et al.*, 1992). Not having been recorded at any other time this is therefore a very rare species in Portugal.

¹ Not to be confused with the author

Mosquito surveys

Surveys have been undertaken in continental Portugal since the year 2000, in order to update the presence and abundance of potential mosquito arbovirus vectors, as well as to monitor mosquito population dynamics in particular areas. Several mosquito collection methods have been used.

Adult mosquitoes were collected by two methods: *i*) CDC (Centers for Disease Control) light traps baited with carbon dioxide (Newhouse *et al.*, 1966) for a minimum of 12-hour periods covering sunset and sunrise; *ii*) indoor resting mosquito collections using battery-powered hand aspirators, mainly in animal shelters. Immature stages were collected in mosquito breeding site surveys with the aid of a standard dipper. Both permanent and temporary breeding sites of various kinds were surveyed. Specimens were identified according to Ribeiro & Ramos (1999).

New locations / results

The conducted surveys have resulted in the following new additions to the distribution of the above mentioned species.

Coquillettidia richiardii was found in a natural reserve, Parque Natural da Ria Formosa, Quinta de Marim, Olhão, Faro district, the only district of the most southern province of the Algarve. This finding relates to adults collected in CDC traps, all females, which were caught respectively in, October 2001 (N = 2), September 2002 (N = 4), July 2004 (N = 2), August 2004 (N = 3) and September 2004 (N = 1).

Anopheles plumbeus adult females were also collected in the same locality and by the same method as above, however, this was only in the year 2004; July (N = 2), August (N = 4), and September (N = 1).

Ochlerotatus berlandi adult females were collected in two localities of the Évora district in 2004, both in rural settings, composed mainly of cork oak woodland: in Amieira by CDC traps placed in an open chicken coop, in May (N = 1) and in July (N = 2), and in Alqueva in May (N = 2), resting inside a chicken coop.

Culex laticinctus was collected as a larva in an artificial tank in Alqueva, Évora district, in October 2004. Water in this tank comes from a well. It was clean, pH 7.14, conductivity 839 μ S and salinity 0.5 ppt (parts per thousand). This larva was raised and developed into a female adult. Another female specimen was collected resting inside a chicken coop in Amieira, Évora district in November 2004.

Finally, one female *Uranotaenia unguiculata* was caught in a CDC light trap in September 2004 in Almancil, Faro district of the Algarve.

Previous and present findings are summarised in Table 1 and depicted in Figure 1.

Discussion

As stated above, *Cq. richiardii* was scantily represented in Portugal, having been recorded in one locality in the northern district of Guarda, with no mention of the number or gender of specimens collected, one specimen in the city of Lisbon, and a third in the district of Setúbal (Table 1). The finding here reported not only refers to a new localisation but also to a sustained presence as it was found in 2001, 2002 and in the three collections of 2004. Parque Natural da Ria Formosa, where this species has lately been found, is a coastal natural reserve, with pine forest, wetland, marshes, small lagoons, and an intricate system of meandering canals which are part of the Formosa river delta. It is, therefore, the perfect biotope for this species, as small lagoons with emerging vegetation abound in the area. It is a bird sanctuary, colonised by an abundant avifauna, of which many are migratory, as this area is situated in the migratory routes between Africa and Europe.

It was in this same habitat that *An. plumbeus* was also found recently. Being a tree-hole-breeding mosquito also makes this place a suitable location. *Anopheles plumbeus* had not been recorded south of the Setúbal district (Ramos, 1983-84), and this new location expands its distribution in Portugal. The fact that *An. plumbeus* was not collected in 2001-2002 despite systematic collections in this area, raises the question of whether its density is increasing or whether it could be a new introduction. In reality, neither *Cq. richiardii* nor *An. plumbeus* were found in the Algarve despite a thorough survey both for adults and immatures (Ramos *et al.*, 1977-78). Regarding adults, perhaps this was due to the fact that CDC light traps were not used in those surveys (Ramos & Ribeiro, personal communication). However, the specimen from the Setúbal district was collected resting inside

a cowshed. As to the hypothesis of introduction, both these species have been found in Spain and throughout Europe (Snow & Ramsdale, 1999; Ramsdale & Snow, 2001). From the regions of Spain that border Portugal, *Cq. richiardii* and *An. plumbeus* have been recorded in the province of Salamanca, though much further north than the present findings (Encinas Grandes, 1982).

Ochlerotatus berlandi and *Cx. laticinctus* were newly found in the Évora district, in the south of the country. Whereas for the former it is not such a different location as it had been found in the Alentejo province, in the Portalegre and Beja districts, for *Cx. laticinctus* it is a completely different area as it had only been previously found in the north, Braga and Porto districts, (Braga, 1931) and from the southernmost district of Faro, in the Algarve (Ramos *et al.*, 1977-78; Ramos *et al.*, 1992).

A female *Ur. unguiculata* was found in Portugal for the first time, as the three previous records were males. It was collected in the Algarve, where it had already been previously recorded (Ramos *et al.*, 1992), though 50 km further west and also by the coast. The two previous findings were from the Alentejo province (Ribeiro *et al.*, 1977-78; Ramos *et al.*, 1992). The fact that it has only been found three times in Portugal despite thorough surveys in the provinces of Algarve and Alentejo (Ramos *et al.*, 1977-78; Pires *et al.*, 1982) and elsewhere (Ribeiro *et al.*, 1988, 1989-1992, 1999, 2002), confirms its rarity. However, it seems to be limited to the south. *Uranotaenia unguiculata* is distributed throughout southern Europe (Ramsdale and Snow, 2001) and in Spain is present not only in the south, Cordoba, but also in Madrid and Barcelona (Encinas Grandes, 1982).

These species, considered endemic for Portugal (Snow & Ramsdale, 1999), are rare, not only in surveys from the seventies and eighties (reviewed in Ribeiro *et al.*, 1988) but also as the findings presented here. The findings reported in this paper were the only recordings in over a thousand collections that have been undertaken throughout the country, since the year 2000 (Galão *et al.*, 2002; Almeida *et al.*, in preparation). The relevance of these findings for *Oc. berlandi*, *Cx. laticinctus* and *Ur. unguiculata* is mainly an update of their distribution in the country, as their importance as vectors of human or zoonotic disease is negligible (Ribeiro *et al.*, 1988). The finding of *An. plumbeus* may be significant as it is a malaria vector and has actually been recently incriminated in the transmission of two malaria cases in Germany (Kruger *et al.*, 2001). However, the density and distribution of this species in Portugal is such that it does not seem to pose a real public health threat. However, larvae of *An. plumbeus* were found associated with *Aedes (Stegomyia) albopictus* (Skuse, 1894) in Belgium (Schaffner *et al.*, 2004), which may have some importance due to the recent finding of the latter in Spain (Aranda *et al.*, 2004).

As for *Cq. richiardii*, it is a vector of arboviral diseases, namely Calovo and Batai, both *Bunyavirus*, and West Nile, a *Flavivirus*, in Europe (Hubálek & Halouzka, 1999; Lundström, 1999; Higgs *et al.*, 2004). This possibility is all the more real considering the particular habitat in which this mosquito species has now been found, in close contact with birds which may be of African origin and reservoirs of various arboviruses. It feeds both on birds and humans and may be a bridge vector (Service, 1971). Furthermore, it was close to this area that mosquitoes infected with West Nile virus were detected in July 2004 (Almeida *et al.*, 2004) and two tourists were putatively infected with West Nile (Anonymous, 2004). The fact that global warming is potentially contributing to the spreading of mosquitoes and therefore the pathogens they transmit, contributes to the importance of this finding (Martens, 1998).

Acknowledgments

To Helena Ramos our consultant for mosquito systematics, and to Henrique Ribeiro, we give thanks for valuable teaching and help. This work was funded by Project "Arbovirus of the mosquitoes from Portugal" POCTI/ESP/35775/99, FCT/MCES; and Project "Rarimosq" funded by Calouste Gulbenkian Foundation, Portugal. J. Pinto was funded by FCT/MCES, Portugal, grant SFRH/BPD/10086/2002.

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Figure 1. Previous (open symbols) and new (solid symbols) findings of *Anopheles plumbeus*, *Ochlerotatus berlandi*, *Coquilletidia richiardii*, *Culex laticinctus* and *Uranotaenia unguiculata* in Portugal.

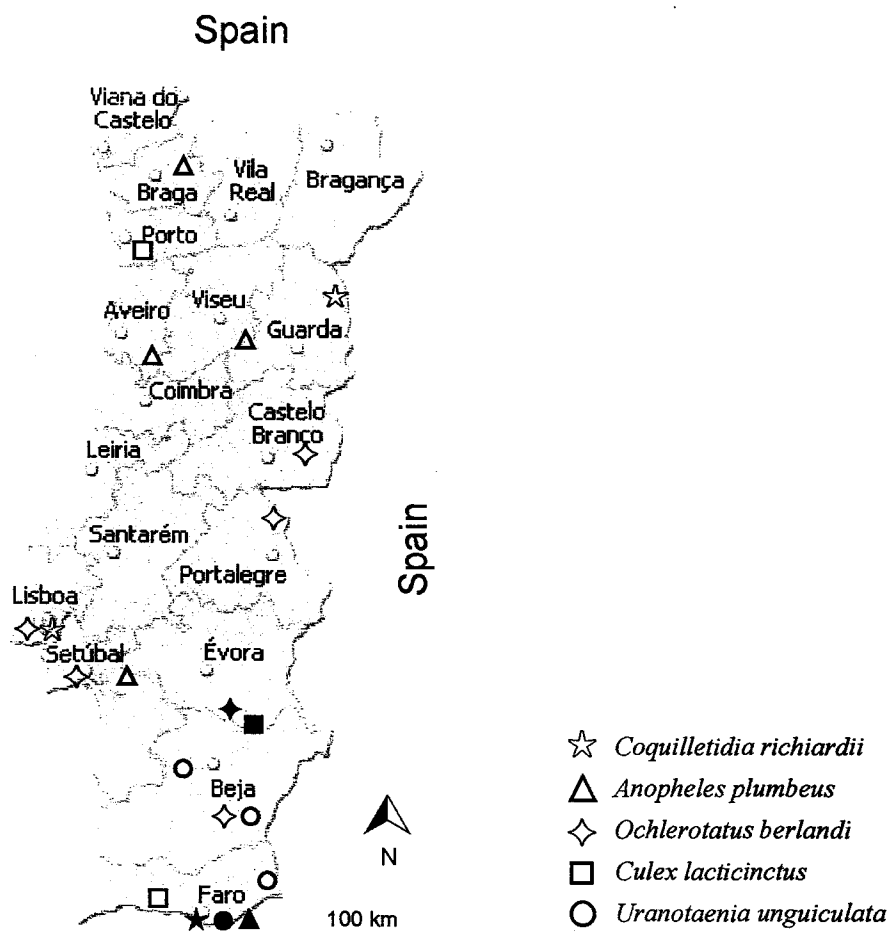


Table 1 – Previous and present findings of *Anopheles plumbeus*, *Ochlerotatus berlandi*, *Coquillettidia richiardii*, *Culex laticinctus* and *Uranotaenia unguiculata* in Portugal.

Mosquito species	Locality, Co-ordinates, Altitude - District	Reference
<i>Coquillettidia richiardii</i>	Pinhel 40°46' N 7°04' W 625 m – Guarda	Braga (1931)
	Águas de Moura 38°35' N 8°41' W 25 m – Setúbal	Unpublished (1976)
	Lisboa 38°41' N 9°10' W sea level – Lisboa	Ribeiro <i>et al.</i> (1988)
New location	Quinta de Marim, Olhão 37°02' N 7°51' W sea level- Faro	2001, 2002, 2004
<i>Anopheles plumbeus</i>	Fornos de Algodres 40°37' N 7°32' W 500 m – Guarda	Braga (1931)
	Ferrador 41°26' N 8°02' W 170 m – Braga	
	Águas de Moura 38°35' N 8°41' W 25 m – Setúbal,	Ramos (1983)
	Buçaco 40°22' N 8°22' W 500 m – Aveiro,	
New location	Quinta de Marim, Olhão 37°02' N 7°51' W sea level- Faro	2004
<i>Ochlerotatus berlandi</i>	Águas de Moura 38°35' N 8°41' W 25 m; Arrábida 38°29' N 9°01' W 140 m – Setúbal	Ribeiro <i>et al.</i> (1977) and Ramos (1983)
	Oeiras 38°42' N 9°19' W sea level – Lisboa,	
	Nisa 39°27' N 7°36' W 250 m – Portalegre,	
	Rosmaninhal 39°43' N 7°05' W 200 m - Castelo Branco	
	Pias 38°04' N 7°28' W 200 m – Beja	Novo & Ramos, unpublished
New location	Amieira 38°17' N 7°33' W 150 m; Alqueva 38°13' N 7°32' W 200 m – Évora	2004
<i>Culex laticinctus</i>	Barcelos 41°30' N 8°38' W 100 m – Braga	Braga (1931)
	Leça da Palmeira 41°10' N 8°41' W sea level – Porto	
	Espartosa 37°09' N 7°50' W 300 m;	
	Stª Catarina 37°09' N 7°47' W 250 m;	Ramos <i>et al.</i> (1977-78)
	S. Bartolomeu de Messines 37°14' N 8°17' W 150 m – Faro	
	Pias 38°04' N 7°28' W 200 m – Beja	Ramos <i>et al.</i> (1992)
New location	Amieira 38°17' N 7°33' W 150 m; Alqueva 38°13' N 7°32' W 200 m – Évora	2004
<i>Uranotaenia unguiculata</i>	Ferreira do Alentejo 38°03' N 8°07' W 150 m – Beja	Ribeiro <i>et al.</i> (1977-78)
	Pias 38°04' N 7°28' W 200 m – Beja	
	Castro Marim 37°13' N 7°27' W 50 m – Faro	Ramos <i>et al.</i> (1992)
First female recorded	Almancil 37°04' N 8°02' W sea level – Faro	2004