A report of *Anopheles algeriensis* (Diptera: Culicidae) from The Netherlands

Ernst-Jan Scholte
Wietse den Hartog
Chantal Reusken

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This manuscript describes the finding of *Anopheles algeriensis* in The Netherlands. Six adult female specimens were collected in a wetland area during a mosquito survey in the National Park 'De Oostvaardersplassen' in August 2009. Although the species has limited importance as a vector due to its rareness in Central Europe, the finding of this species is interesting because of the extremely patchy distribution and small population sizes of this species, even in its native area of southern Europe.

Introduction

In a review by Ramsdale & Snow (2000), eighteen *Anopheles* species were reported for Europe, of which *An. maculipennis s.s.* Meigen, 1818, *An. atroparvus* Van Thiel, 1927, *An. messae* Falleroni, 1926, *An. melanoon* Hackett, 1934, *An. claviger* (Meigen, 1804) and *An. plumbeus* Stephens, 1828, are known to occur in The Netherlands (Verdonschot 2002). In the present report, we describe the finding of six specimens of yet another species: *Anopheles* (*Anopheles*) *algeriensis* Theobald, 1903.

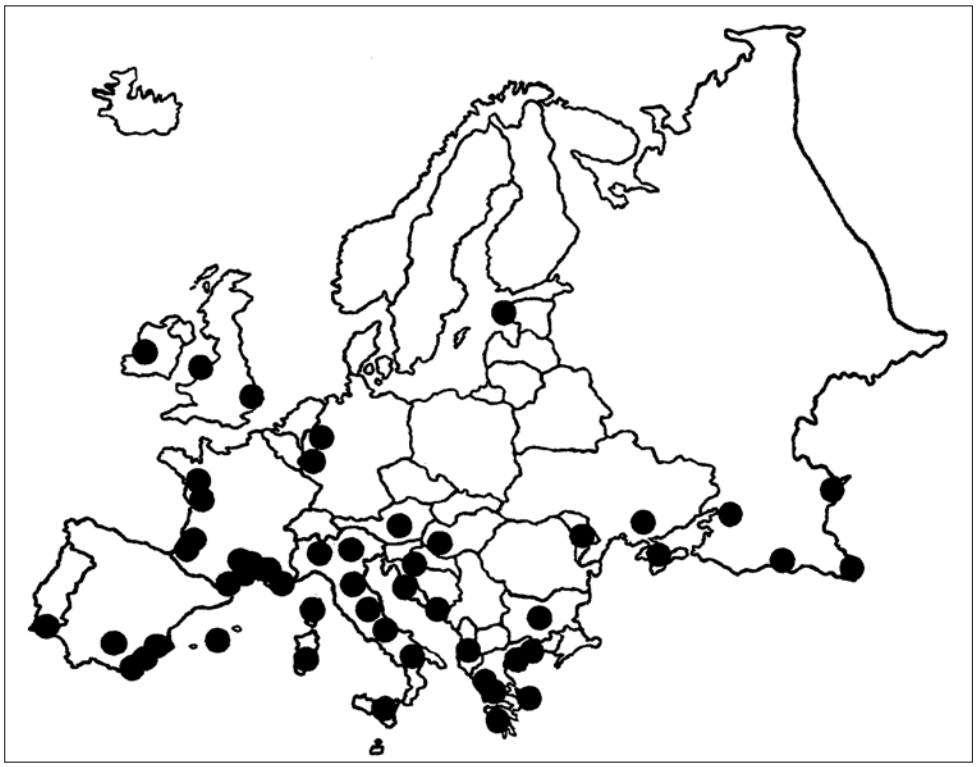
The main distribution of *Anopheles algeriensis* has been reviewed by Ramsdale & Snow (2000) and encompasses the Mediterranean basin and the Balkans, with an eastward extension into Iraq, Iran and, northwards through the Caucasus, into middle Asia, with some isolated populations from the northern part of Central Europe (above the Alps), including Britain (Rees & Snow 1989; Snow *et al.* 1998), Estonia (Remm 1957), Germany (Mohrig 1969), western France (Ramsdale & Snow 2000), and Ireland (Ashe *et al.* 1991) (figure 1).

Larval breeding sites of *An. algeriensis* are generally marshes and slow running brooks overgrown with vegetation (Schaffner *et al.* 2001) and sites where groundwater emerges (Ponçon *et al.* 2007). Here, we report the finding of six specimens of *An. algeriensis* from the National Park 'De Oostvaardersplassen', a wetland area in the Flevoland polder in The Netherlands. It consists of open grassland with sparse shrubs, ponds, marches, canals, and deciduous forest. In the study area (Oostvaardersveld), a group of approximately 100 Konik horses are present, spending most of their time in an open grassland area in the north-eastern part of the Oostvaardersveld. In the middle of this open grassland lies a shallow, permanent pond with high numbers of birds (mostly geese and various duck species). This area of open grassland is surrounded by deciduous forest (mostly willow). In some parts of this forest, regularly floodings occur, creating marshes.

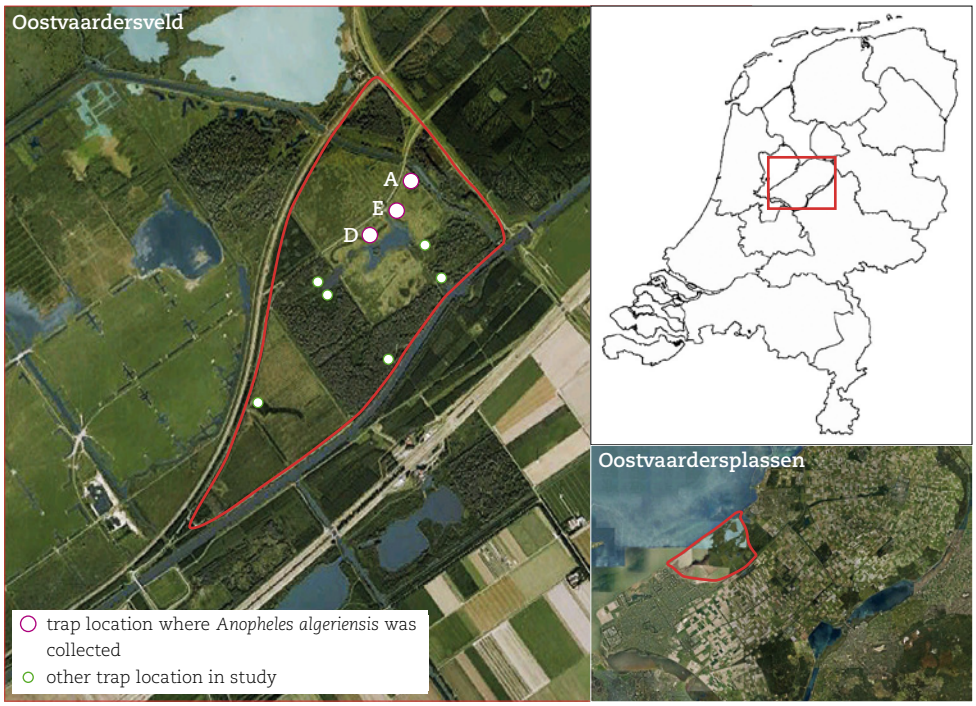
Materials and methods

Adult mosquitoes were collected as part of a West Nile Virus (WNV) surveillance study, in which the presence of potential WNV vectors in the Oostvaardersplassen (The Netherlands) was studied, combined with WNV testing of collected mosquitoes. This area is considered as a high risk area for the introduction and enzootic circulation of WNV due to the presence of favourable ecological conditions for the interaction between resident bird reservoirs, migratory bird reservoirs and competent ornithophilic vectors . Details of this study are described in Reusken *et al.* (2010). Traps were placed in the 'Oostvaardersveld', an area of 328 ha in the south-eastern corner of De Oostvaardersplassen (figure 2).

Adult mosquitoes were collected using nine carbon dioxide baited traps of the type Mosquito Magnet Liberty Plus® (American Biophysics, USA), with 1-octen-3-ol as additional lure (figure 3). Mosquitoes were collected for two consecutive days in week 33 (10-12 August 2009) and again in week 35 (24-26 August 2009). For the entire duration of the experiment, the traps ran continuously. The traps were placed in the morning of the 10th of August. The nets were collected and replaced with empty nets after 24 hrs (11th of August). These new nets were subsequently collected 24 hrs later (12th of August). In the second period the same procedure was followed: traps were switched on in the morning of the 24th of August, and nets collected on the 25th and 26th. Within a maximum of three hours after collection from the trap, the mosquitoes, which were still alive, were killed by cooling them to -20 °C. Mosquitoes were then identified using a key specifically designed for rapid field-identification of Dutch female Culicidae (Scholte 2009; modified after Schaffner *et al.* 2001, Becker *et al.* 2003, Snow 1990 and Verdonschot 2002). A subset of the diagnosed mosquitoes (among which the *An. algeriensis* specimens), were later checked by Culicidae taxonomist F. Schaffner. After confirmation of the species diagnostics, these specimens were labelled and kept in the CMV Culicidae collection of the National Centre for Monitoring of Vectors (CMV).



1. Locations from which *Anopheles algeriensis* has been reported (From: Ramsdale & Snow 2000; used with permission from EMB).
1. Locaties waar *Anopheles algeriensis* is gerapporteerd (Van: Ramsdale & Snow 2000; gebruikt met toestemming van EMB).



2. Satellite photo (Google Maps), of the Oostvaardersveld, the study site where, among other species, six specimens of *Anopheles algeriensis* were collected.
2. Satellietfoto (Google Maps) van het Oostvaardersveld, de locatie waar de vallen waren geplaatst en waar onder andere zes specimens van *Anopheles algeriensis* waren aangetroffen.

Results

In a total of 32 samples, 410 mosquitoes were collected (for details see Reusken *et al.* 2010). The identified species were *Coquillettidia richardii* (Ficalbi, 1889), *Culex modestus* Ficalbi, 1890, *C. pipiens* Linnaeus, 1758, *C. torrentium* Martini, 1925, *Culiseta annulata* (Schrank, 1776), *C. morsitans* (Theobald, 1901), *C. subochrea* (Edwards in Wesenberg, 1921), *Aedes cantans* (Meigen, 1818), *Ae. geniculatus* (Olivier, 1791), *Anopheles claviger*, *An. maculipennis s.l.*, *An. plumbeus*, and, interestingly, six specimens of *An. algeriensis*.

Anopheles algeriensis was found in three of the nine traps, all three located in the north-eastern area of the Oostvaardersveld. On the 12th of August, one specimen was collected from trap A, and four specimens from trap D (figure 2). The sixth specimen was collected on the 25th of August, from trap D.

Discussion

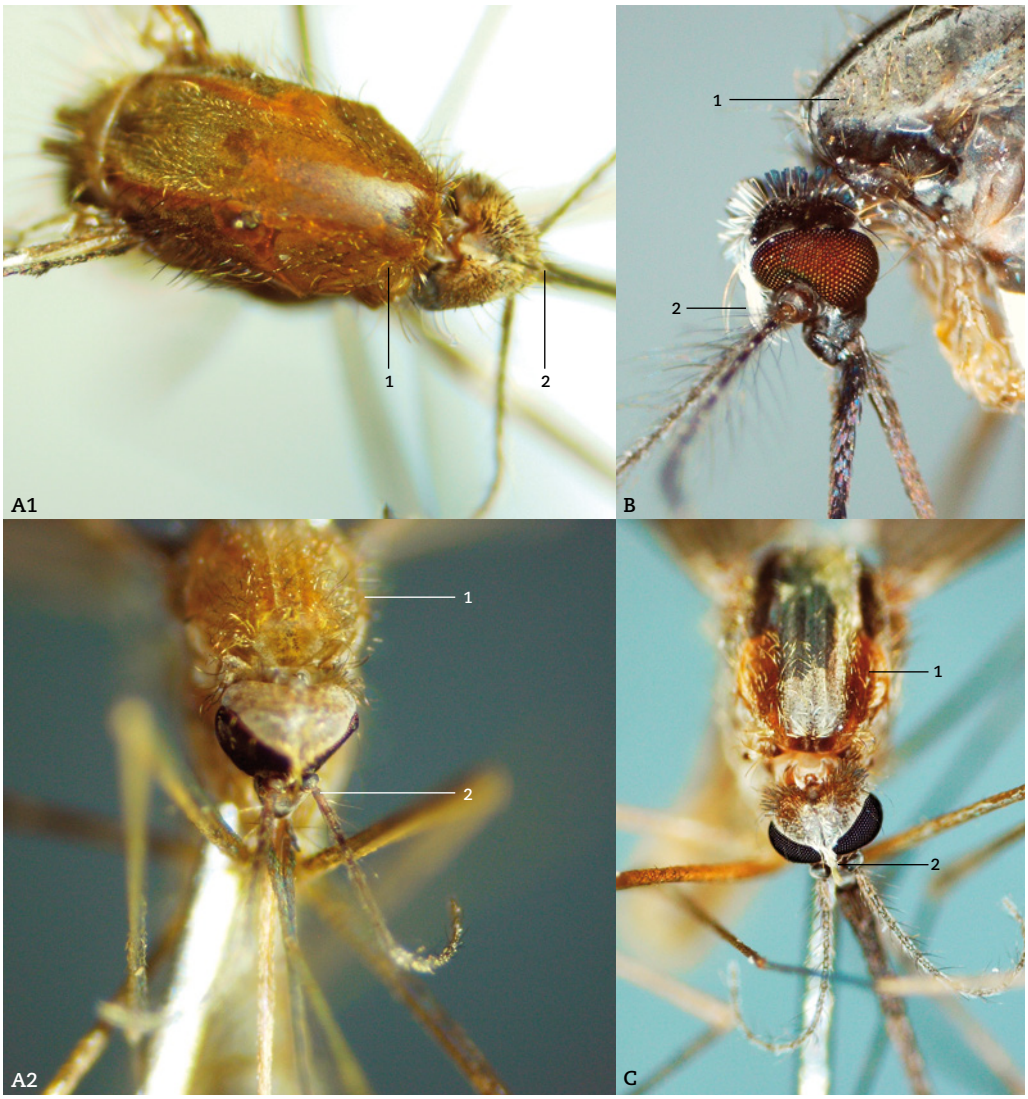
Anopheles algeriensis was listed twice as an indigenous species from The Netherlands. First, by Verdonschot (2002) who based its presence only on the fact that *An. algeriensis* had been reported from both Germany and the United Kingdom, thereby assuming that the species would be present in The Netherlands as well (personal communication P.F.M. Verdonschot). However, the species had never been collected from The Netherlands. The second report was published by Huijben *et al.* (2007). In this study, a total of 575 mosquitoes had been collected in the Rotterdam Zoo. Three specimens of these were identified as *An. algeriensis*, using the key of Van Haren & Verdonschot (1995). Unfortunately, identifications of these specimens were not verified by a Culicidae taxonomist, and no specimens were stored.

3. The mosquito trap 'Mosquito Magnet' type 'Liberty Plus®', that was used in this study. Photo: Renate Smallegange
3. De muggenval 'Mosquito Magnet' type 'Liberty Plus®', die tijdens deze studie is gebruikt.

The keys of Van Haren & Verdonschot (1995) and Becker *et al.* (2003) uses the absence of light-coloured scales on the median part of the scutum and on the vertex as diagnostic for *An. algeriensis* (character 1 in figure 4). The key by Schaffner *et al.* (2001) uses only the absence of a tuft of white long scales protruding between the eyes as diagnostic (character 2 in figure 4). The key of Snow (1990) uses both characters. Differentiation between the two other known Dutch indigenous *Anopheles* species without wing spots (*An. claviger* and *An. plumbeus*) with the specimens that were diagnosed as *An. algeriensis* was done by comparing both characters with specimens of both other species that were collected in the present study (figure 4).

Despite the fact that *An. algeriensis* is competent in transmitting *Plasmodium vivax* in the United Kingdom (Ramsdale & Snow 2000) and Germany (Mohrig 1969) and that it feeds on blood of humans (Schaffner *et al.* 2001, Ponçon *et al.* 2007), it has a very low vector capacity for malaria due to its rareness (Schaffner *et al.* 2001). The species is therefore not considered as a malaria vector of any importance. It is not known to be a vector of other mosquito-borne pathogens.

Although most breeding sites of *An. algeriensis* are known from the Mediterranean Basin (Ramsdale & Snow 2000) the species is also rare in this region (Schaffner et al. 2001; Ponçon *et al.* 2007). It is considered even more rare in Central Europe: the report of Ireland consisted of only one specimen (Ashe *et al.* 1991), the two populations in Germany were reported only once (Mohrig 1969), and, despite searches, the present status of this mosquito is uncertain in Norfolk (Cranston *et al.* 1987), which leaves



4. Photos of *Anopheles algeriensis* (A1 and A2) collected from the Oostvaardersplassen. Numbers 1 and 2 indicate the diagnostic characters for which *An. algeriensis* can be differentiated from the two other Dutch Anopheles species that have no wingspots: *An. plumbeus* (B) and *An. claviger* (C): Number 1 indicates the coloration of the scutum, which is uni-coloured brown in *An. algeriensis*, greyish-black in *An. plumbeus*, and contains light coloured scales on the scutum sides in *An. claviger* (Snow 1990, Schaffner 2001). Number 2 indicates the tuft of long white scales between the eyes which are absent in *An. algeriensis* and present in the other two species. Photos: Wietse den Hartog, CMV
4. Foto's van *Anopheles algeriensis* specimens (A1 en A2) die zijn verzameld in de Oostvaardersplassen. Nummers 1 en 2 geven de diagnostische factoren aan waarmee *An. algeriens* van de twee andere Nederlandse Anopheles soorten zonder vleugelvlekken kan worden onderscheiden (*An. plumbeus* (B) en *An. claviger* (C). Nummer 1 geeft de kleur van het scutum aan, dat éénkleurig bruin is bij *An. algeriensis*, grijs-zwart bij *An. plumbeus*, terwijl de zijkanten van de scutum van *An. claviger* lichtgekleurde schubben bevat (Snow 1990, Schaffner 2001). Nummer 2 geeft het kuifje van lange witte schubben tussen de ogen aan die afwezig zijn bij *An. algeriensis* en aanwezig zijn bij de twee andere soorten.

only one population in the United Kingdom: Anglesey in Wales. Most probably *An. algeriensis* is one of the rarest mosquito species in Central Europe. More surveys in 'De Oostvaardersplassen' in subsequent years will hopefully provide more information on the size of its population.

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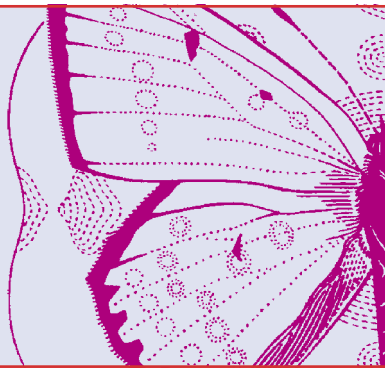
Samenvatting

Een beschrijving van *Anopheles algeriensis* (Diptera: Culicidae) uit Nederland

Dit manuscript beschrijft de vondst van *Anopheles algeriensis* Theobald in Nederland. Zes volwassen vrouwtjes werden verzameld tijdens een muggensurveillancestudie in Nationaal Park 'De Oostvaardersplassen' in augustus 2009. Hoewel de soort vanwege z'n zeldzaamheid van gering belang is als vector voor de malariaveroorzakende *Plasmodium vivax* in Centraal-Europa, is deze vondst interessant vanwege de extreme versnipperdheid en kleine populatiegroottes van deze soort, zelfs in Zuid-Europa, zijn oorspronkelijk gebied.



Ernst-Jan Scholte & Wietse den Hartog
National Centre for Monitoring of Vectors
Ministry of Economy, Agriculture, and Innvovation
P.O. Box 9102
6700 HC, Wageningen
The Netherlands
e.j.scholte@minlnv.nl

Chantal Reusken
Laboratory for Zoonoses and Environmental Microbiology
Centre for Infectious Disease Control Netherlands
Van Leeuwenhoekweg 1
3720 BA Bilthoven
The Netherlands