

Distribution of *Anopheles* mosquitoes in the British Isles

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In the British Isles five species of *Anopheles* have been recorded, all grouped within the subgenus *Anopheles*. They are *An. atroparvus* van Thiel, *An. algeriensis* Theobald, *An. messeae* Falleroni, *An. claviger* (Meigen) and *An. plumbeus* Stephens. Although Edwards (1936) suspected the existence of *An. maculipennis s.s.*, its presence in the British Isles has never been established. Renewed interest in the distribution of *Anopheles* mosquitoes and their ability to transmit malaria has arisen in recent years owing to the potential effects of global warming on insects and insect-borne pathogens in Europe.

Malaria transmission

In the British Isles malaria was transmitted in the valleys and marshlands where suitable mosquito vectors were found. The most efficient vector was *An. atroparvus* and this was the chief source of the benign tertian form of malaria, caused by the protozoan parasite *Plasmodium vivax*, occurring in these islands. The disease was commonly called ague and was especially rife in the marshlands and estuaries of East Anglia, Essex, Kent and the counties of the south coast of England. Although there is no evidence for the British Isles, it is interesting that *An. messeae* was formerly the main vector of malaria over a large part of European Russia (Detinova, 1953) In 1953 two cases of *vivax* malaria occurred in Lambeth, London. *An. plumbeus* was suspected to be the vector as it was found breeding in a collection of water in the hollow of a plane tree close to the house where the cases of malaria occurred (Shute, 1954).

Blacklock (1921) reported a case of *falciparum* malaria in "a northern health resort" in 1920. However many studies have shown that native *An. atroparvus* are incapable of transmitting this species of malarial parasite (James *et al.*, 1932; Shute, 1940). More recently Ramsdale & Coluzzi (1975) found no infectivity in two southern European species, *An. atroparvus* and *An. labranchiae* and Ribeiro *et al.* (1989) showed that Portuguese *An. atroparvus* were not susceptible to strains of *P. falciparum* from East Africa. However, a study by Marchant (1997) indicated that *An. plumbeus* collected from southern England might be capable of transmitting *P. falciparum* (Nijmegen strain). Of five mosquitoes that fed successfully on blood containing the malarial parasite, three revealed oocysts, an intermediate stage of the parasite, in their midguts. Whether the parasite is capable of completing its life cycle and being transmitted to produce infection is still to be determined.

Anopheles distribution

The first attempt to map *Anopheles* in England and Wales was by Nuttall *et al.* (1901) who plotted the known distribution of the genus as part of an investigation into ague (malaria). However, they did not distinguish between species. Although widespread, most were found in southeast England with some records from the remainder of England and Wales, with the exception of Yorkshire and Lancashire.

There followed a detailed study for England and Wales by Lang (1918). He recorded the occurrence of the three species recognised at that time, namely *An. claviger* (as *An. bifurcatus*), *An. maculipennis* and *An. plumbeus*. It was not until the 1920s that *maculipennis* was recognised as a complex of species (e.g. van Thiel, 1927) with *atroparvus* and *messeae* present in Britain. The next contribution came when Ashworth (1927) presented distribution records for Scotland. Ashe *et al.* (1991) provided a comprehensive review of the culicids of Ireland and mapped the distribution of *An. algeriensis*, *An. claviger*, *An. plumbeus* and *An. maculipennis s.s.*

The maps for England, Scotland and Wales in this publication were produced from data stored in a computer database (Microsoft Excel) and plotted by a program developed at the University of East London. All records are plotted on a 10km grid (small dots). Data have been gleaned from published records, from museums and private collections, and from records held by the British Mosquito Recording Scheme. The maps of Ireland are based on those published by Ashe *et al.* (1991) and are plotted on a 50km grid (large dots).

***Anopheles algeriensis* (Fig. 1)**

The main distribution of *An. algeriensis* is in Mediterranean countries, but it was recorded in Norfolk as adults and larvae in Catfield, Hicklin Broad, Waxham and Foulden Common (Edwards, 1932) and for a further 20 years (Hart, 1954). The present status of this mosquito in Norfolk is uncertain. A search of Foulden Common, Norfolk in 1989 failed to find this mosquito (A. T. Rees & A. E. Rees, unpublished).

Morgan (1987) recorded a female of *An. algeriensis* attempting to bloodfeed at Cors Goch Nature Reserve in Anglesey, and in a subsequent survey Rees & Rees (1989) found larvae in shallow unpolluted water, in fenland. In a survey of the Cors Goch area at the end of 1997, third instar larvae of *An. algeriensis* were found, indicating that the species is established in Anglesey (A.T. Rees, pers. comm.). A female was also recorded in Clare in the west of Ireland in 1989 (Ashe *et al.*, 1991). Like the specimens from England and Wales, this was from a limestone region which may indicate the disparate distribution of this species in the British Isles.

***Anopheles atroparvus* and *Anopheles messeae* (Figs. 2-4)**

These two members of the *maculipennis* complex are morphologically identical except for the patterning on the decks of the eggs. Because of the difficulty in separating these species, most records, especially those predating the recognition of the two species as distinct, are imprecise. Since such records represent the majority of those available, they are included as *An. maculipennis s.l.* in Fig. 2. *An. maculipennis s.s.* is widely distributed throughout England, Scotland, Wales and Ireland. The occurrence of the individual members of the complex is poorly documented and little can be concluded from the few precise records.

***Anopheles claviger* (Fig. 5).**

An. claviger is found throughout England, Scotland, Wales and Ireland with a most northerly record of Lochinver, Highland (Marshall, 1938). It is the most widely recorded *Anopheles* in the British Isles which perhaps reflects its wide range of aquatic development sites which include pools, ponds, ditches, streams, canals, and artificial collections of water in troughs and rain butts. It has been recorded in clean and polluted fresh and brackish waters.

***Anopheles plumbeus* (Fig. 6).**

An. plumbeus is widely distributed throughout England, Scotland, Wales and Ireland with a most northerly record of Skibo Castle, Highland (Marshall, 1938). Although the immature stages are found only in water-filled tree holes these are often widely located in woodlands, parks and recreational areas, urban roads and motorway verges.

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Fig. 3. Recorded distribution of *Anopheles atroparvus*

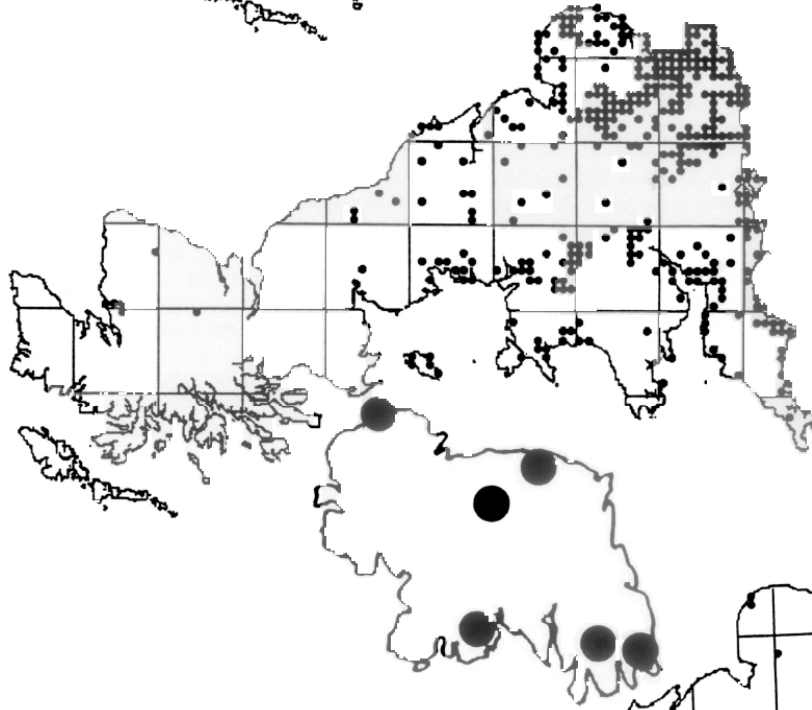
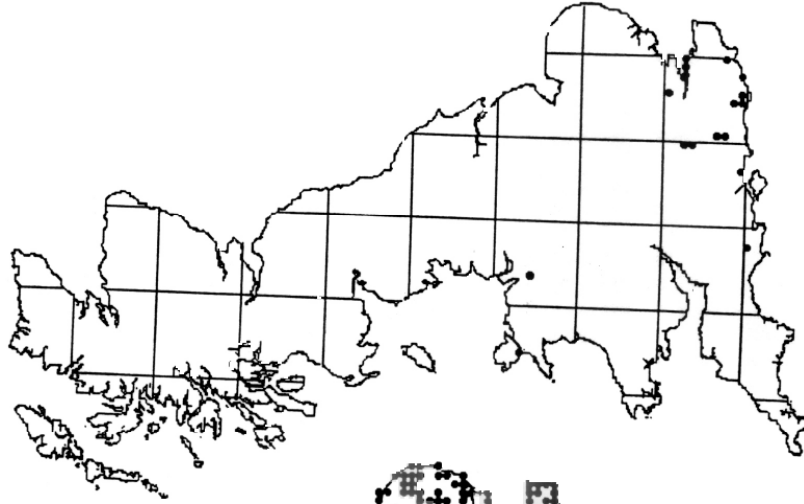


Fig. 2. Recorded distribution of *Anopheles maculipennis s.l.*

Fig. 1. Recorded distribution of *Anopheles algeriensis*

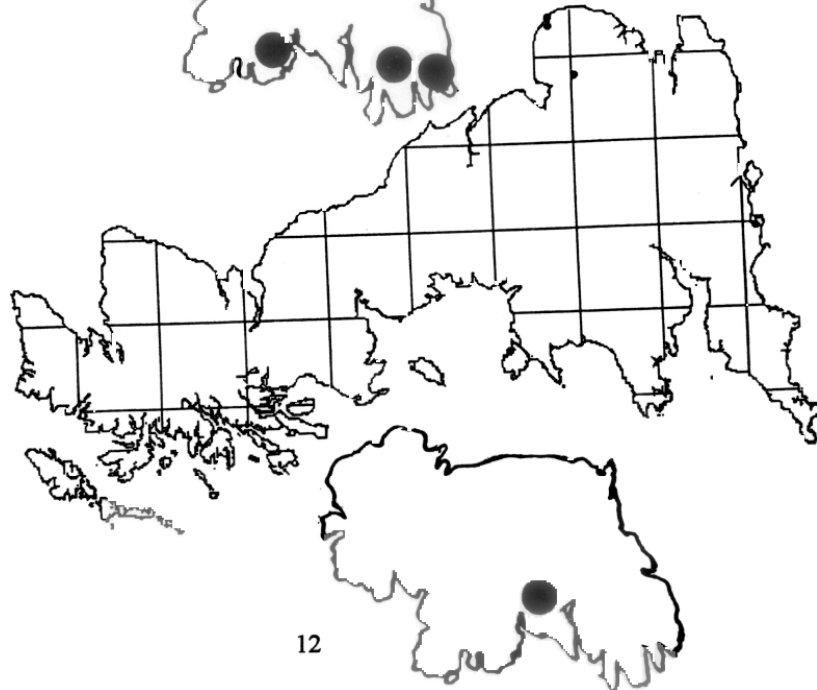


Fig. 6. Recorded distribution of
Anopheles plumbeus

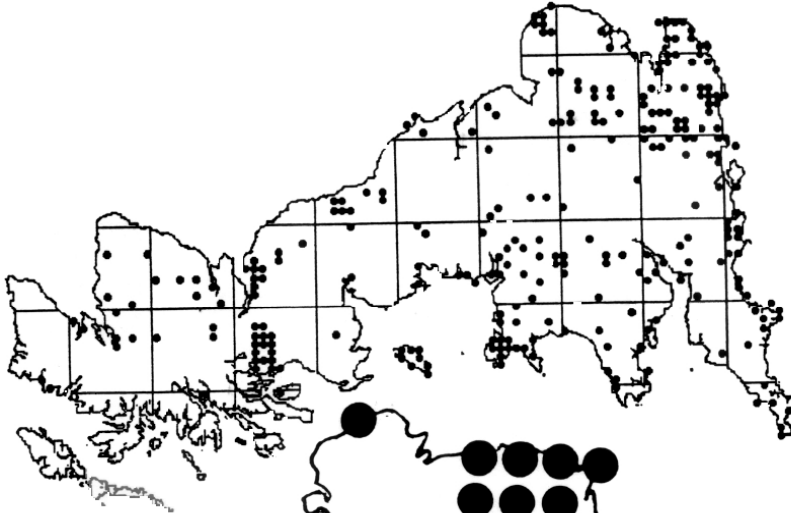
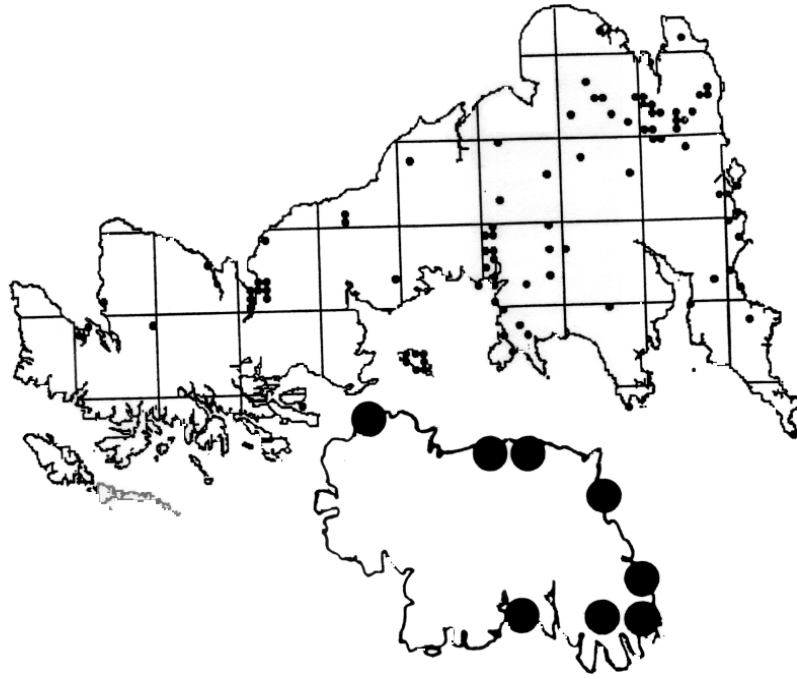


Fig. 5. Recorded distribution of
Anopheles claviger

Fig. 4. Recorded distribution of
Anopheles messeae

