European Mosquito Bulletin ***28*** *(2010), pp 208-212*
Journal of the European Mosquito Control Association
ISSN 1460-6127; w.w.w.e-m-b.org
First published online October 22 2010

Aircraft-mediated transport of *Culex quinquefasciatus*. A case report.

Ernst-Jan Scholte[1*], Marieta Braks[2] and Francis Schaffner[3]
[1] National Centre for Monitoring of Vectors, Ministry of Agriculture, Nature, and Food Quality, Wageningen, The Netherlands [2] National Institute for Public Health and the Environment (RIVM), Bilthoven, the Netherlands [3] Institute of Parasitology, University of Zurich, Switzerland

*Corresponding author: P.O.Box 9102, 6700 HC Wageningen, The Netherlands; Email: e.j.scholte@minlnv.nl

Abstract

The identification of four female *Culex quinquefasciatus* mosquitoes collected in the passenger cabin of an aircraft on a direct flight from Dar es Salaam (Tanzania) to the Netherlands is described. The risk of importation of mosquitoes in aircraft and of their subsequent establishment is discussed.

Key words: aircraft, transport, *Culex quinquefasciatus*

Introduction

Air traffic is known to be an important pathway for the global dissemination of vectors and the diseases they transmit (Gezairy, 2003; Gratz *et al*., 2000; Lounibos, 2002, Tatem *et al*., 2006; Van der Weijden *et al*., 2007). Mosquitoes can survive long flights (Russell, 1987, 1989), escape from aircraft upon landing and manage to colonize new areas (Gratz *et al*., 2000). When mosquitoes are infected with a human pathogen, travellers either in the plane or at the airport, and also airport employees and inhabitants of adjacent areas, are at risk of infection. Over the last half century, vectors of yellow fever, dengue, and malaria have been found in aircraft (DeHart, 2003). During the last 30 years, the risk of accidental spread of mosquitoes and mosquito-borne pathogens has increased dramatically due to huge increases of air traffic, especially to and from tropical regions (Gratz *et al*., 2000). The main Dutch airport, Schiphol, is one of the major international airports of Europe. In 2008, Schiphol Airport received a total of 7,605 flights from Africa, 2,622 from Central America, 2,074 from South America, and 3,808 flights from South-Eastern Asia (Schipol Group, 2008; Central Bureau of Statistics, 2010), all of which include areas in which mosquito-borne diseases such as malaria, dengue and chikungunya, are endemic. Here, we report on the collection of four wild tropical mosquitoes during a flight from Africa to Europe.

Materials and methods

During a direct flight from Dar es Salaam (Tanzania) to Schiphol airport (the Netherlands) in mid-November 2008, four mosquitoes were collected. The mosquitoes were manually captured by a flight attendant following complaints by passengers of mosquito biting nuisance. Prior to Dar es Salaam, the airplane came from Sao Paolo (Brazil). The four specimens were killed and 'sandwiched' between doubled adhesive tape. Upon arrival at Schiphol, these specimens were handed to a medical doctor from the KLM Health Service at the airport, who forwarded them to the National Institute for Public Health and the Environment (RIVM) for morphological examination. Additionally PCR sequencing (Synergene, Schlieren, Switzerland) of the ACE locus (Smith & Fonseca, 2004) was performed with two of the specimens.

Results

All four specimens were morphologically diagnosed as belonging to the *Culex pipiens* species complex. The partial sequences of the ACE locus showed 99.8% (538/539 bp, GenBank entry FJ416011) identity with *Culex quinquefasciatus* Say.

Discussion

Culex quinquefasciatus, commonly known in North America as the southern house mosquito, is not endemic in Europe but occurs in tropical and subtropical areas around the world. In many areas, it is the most common urban mosquito. It breeds in polluted standing water, often containing rotting organic matter. The species is known to bite people, although it also readily feeds on birds. It is the primary vector of *Wuchereria bancrofti* (Janousek & Lowrie, 1989), causative agent of lymphatic filariasis. It has also been incriminated as a vector of West Nile virus (Blackmore *et al*., 2003) and *Dirofilaria immitis* (Brito *et al.*, 1999), and is considered to be a potential vector of Saint Louis encephalitis virus.

The species is repeatedly intercepted on aircraft (see Gratz, 2000) and has accounted for the majority of airborne mosquitoes in several investigations (Goh *et al*., 1985; Karch *et al*., 2000; Hutchinson *et al*., 2005). Recently, Bataille *et al.* (2009) reported repeated introductions of *Cx. quinquefasciatus* by aircraft flying into the Galápagos Islands. *Culex quinquefasciatus* has never previously been reported from the Netherlands.

Live mosquitoes on board aeroplanes may be infected with a pathogen which could be transmitted to humans during the flight (Mouchet *et al*., 1995) or even after the mosquitoes, either actively or passively (in luggage), have left the plane. Moreover, these mosquitoes may become endemic in these new territories. Evidence for this was reported by Mouchet *et al.* (1995), who stated, 'as soon as airports were built on the islands of French Polynesia, they were all colonized by *Aedes aegypti*[1]'.

[1] = *Stegomyia aegypti* sensu Reinert *et al*. 2004

Surprisingly, despite the high number of airway routes and flights, most well-described successful introductions of invasive species into Europe are not thought to be related to air traffic, but rather to the international maritime trade in used tyres. Examples are the introduction of *Aedes albopictus*[2] into Italy (Enserink, 2008), of *Aedes japonicus*[3] into Belgium (Versteirt *et al*., 2009) and France (Schaffner *et al*., 2003), and of *Aedes atropalpus*[4] into France (2003, 2005), Italy (1996) and the Netherlands (2009) (Scholte *et al.*, 2009). Another example of a maritime introduction pathway is of *Ae. albopictus* in imported shipments of the ornamental plant, Lucky Bamboo (Scholte *et al*., 2008), into glasshouses in the Netherlands. The introduction pathway for *Ae. japonicus* into Switzerland has not been clearly identified, but no direct link to air traffic has been discovered (Schaffner *et al*., 2009). Apparently, successful establishment of aircraft-borne mosquitoes is a rare event, presumably due to difficulties experienced by invading mosquitoes of adapting to new conditions, or because numbers of individuals are too low to establish a founder population. However, given the high numbers of incoming flights from tropical and sub-tropical areas, and the ability of mosquitoes to survive long-distance flights in aircraft, the risks of introduction of exotic mosquito species are considered by the ECDC to be real (ECDC Report, 2009). Under favourable circumstances such as the presence of suitable local climatic conditions and breeding sites, mosquitoes transported in aircraft could lead to establishment of immigrant vector species and increased probability of disease transmission in or around international airports.

Acknowledgements

The authors wish to thank Sietse Felix (MD, KLM health services) for collaboration and for providing the collected specimens, Jeannine Hauri (IPZ, UZH, Zurich) for performing the molecular investigation and the Dutch Ministries of LNV (Agriculture, Nature and Food Quality) and VWS (Public Health) for financial support.

References

Bataille, A., Cunningham, A.A., Cedeño, V., Cruz, M., Eastwood, G., Fonseca, D.M., Causton, C.E., Azuero, R., Loayza, J., Cruz, J.D. & Goodman, S.J. (2009) Evidence for regular ongoing introductions of mosquito disease vectors into the Galápagos Islands. *Proceedings of the Royal Society B: Biological Sciences* **276**, 3769-3775.

Blackmore, C., Stark, L., Jeter, W., Oliveri, R., Brooks, R.G., Conti, L.A. & Wireman, S.T. (2003) Surveillance results from the first West Nile virus transmission season in Florida, 2001. *American Journal of Tropical Medicine and Hygiene* **69**, 141–150.

Brito, A.C., Fontes, G., Rocha, E.M.M., Rocha, D.A.M. & Regis, L. (1999) Development of *Dirofilaria immitis* (Leidy) in *Aedes aegypti* (L.) and *Culex quinquefasciatus* (Say) from Maceió, Alagoas, Brazil. *Memória do Instituto Oswaldo Cruz* **94**, 575-576.

[2] = *Stegomyia albopicta* sensu Reinert *et al*. 2004

[3] = *Ochlerotatus (Finlaya) japonicus* sensu Reinert *et al*. 2004 = *Hulecoeteomyia japonica* sensu Reinert *et al.* 2006

[4] = *Ochlerotatus atropalpus* sensu Reinert *et al.* 2004 = *Georgecraigius (Georgecraigus) atropalpus* sensu Reinert *et al.* 2006.

Central Bureau of Statistics (CBS) (2010) Luchtvaart, regionale luchthavens. http://statline.cbs.nl/StatWeb/publication/?DM=SLNL&PA=37478hvv&D1=02,11,42,73&D2=0-1&D3=155-188&VW=T (website visited 7 May 2010).

DeHart, R. (2003) Health issues of air travel. *Annual Review of Public Health* **24**, 133-151.

ECDC (2009) Development of *Aedes albopictus* risk maps. *ECDC technical report*. May 2009. 45 pp.

Enserink, M. (2008) A mosquito goes global. *Science* **320**, 864-866.

Franco-Parades, C. & Santos-Preciado, J.I. (2006) Problem pathogens: prevention of malaria in travellers. *Lancet Infectious Diseases* **6,** 139–149.

Gezairy, H.A. (2003) Travel epidemiology: WHO perspective. *International Journal of Antimicrobial Agents* **21**, 86–88.

Gratz, N.G., Steffen, R. & Cocksedge, W. (2000) Why aircraft disinsection? *Bulletin of the World Health Organization* **78**, 995-1004.

Goh, K.T., Ng, S.K. & Kumarapathy, S. (1985) Disease-bearing insects brought in by international aircraft into Singapore. *Southeast Asian Journal of Tropical Medicine and Public Health* **16**, 49-53.

Hutchinson, R.A., Bayoh, M.N. & Lindsay, S.W. (2005) Risk of airport malaria in UK. *European Mosquito Bulletin* **19**, 12-13.

Janousek, T.E. & Lowrie, Jr. R.C. (1989) Vector competence of *Culex quinquefasciatus* (Haitian strain) following infection with *Wuchereria bancrofti*. *Transactions of the Royal Society of Tropical Medicine and Hygiene* **83**, 679-680.

Karch, S., Dellile, M.F., Guillet, P. & Mouchet, J. (2001) African malaria vectors in European aircraft. *The Lancet* **357**, 235.

Lounibos, L.P. **(**2002) Invasions by insect vectors of human disease. *Annual Review of Entomology* **47**, 233-66.

Mouchet, J., Giacomanini, T. & Julvez, J. (1995) La diffusion anthropiques des arthropodes vecteurs des maladies dans le monde. *Cahiers d'etudes et de recherches francophones/Sante* **5**, 293-298.

Queyriaux, B., Pradines, B., Hasseine, L., Coste, S., Rodriguez, P., Coffinet, T., Haus Cheymol, R. & Rogier, C. (2009). Airport malaria. *La Presse Médicale* **38**, 1106-9 (in French).

Russell, R.C. (1987) Survival of insects in the wheelbays of Boeing 747B aircraft on flights between tropical and temperate airports. *Bulletin of the World Health Organization* **65**, 659–662.

Russell, R.C. (1989) Transport of insects of public health importance on international aircraft. *Travel Medicine International* **7**, 26–31.

Schaffner, F., Chouin, S. & Guilloteau, J. (2003) First record of *Ochlerotatus (Finlaya) japonicus japonicus* (Theobald, 1901) in metropolitan France. *Journal of the American Mosquito Control Association* **19**, 1-5.

Schaffner, F., Kaufmann, C., Hegglin, D. & Mathis, A. (2009). The invasive mosquito *Aedes japonicus* in Central Europe. *Medical and Veterinary Entomology* **23**, 448-451.

Schiphol Group (2008) Monthly transport & traffic statistics. http://www.Schipholgroup.com/AboutUs/Information/FactsFigures/MonthlyTransportandTrafficStatistics.htm (accessed May 27, 2009).

Scholte, E.J., Dijkstra, E., Blok, H., De Vries, A., Takken, W., Hofhuis, A., Koopmans, M., De Boer, A. & Reusken, C.B. (2008) Accidental importation of the mosquito *Aedes albopictus* into the Netherlands: a survey of mosquito distribution and the presence of dengue virus. *Medical and Veterinary Entomology* **22**, 352-358.

Scholte, E.J., Den Hartog, W., Braks, M., Reusken, C., Dik, M. & Hessels, A. (2009) First report of a north American invasive mosquito species, *Ochlerotatus atropalpus* (Coquillett) in the Netherlands, 2009. *Eursurveillance* **14** (45), pii=19.400.

Smith, J.L. & Fonseca, D.M. (2004) Rapid assays for identification of members of the *Culex* (*Culex*) *pipiens* Complex, their hybrids, and other sibling species (Diptera: Culicidae). *American Journal of Tropical Medicine and Hygiene* **70**, 339-345.

Tatem, A.J., Rogers, D.J. & Hay, S.I. (2006) Estimating the malaria risk of African mosquito movement by air travel. *Malaria Journal* **14**, 57.

Van der Weijden, W.J., Marcelis, R.A.L. & Reinhold, W. (2007) Invasions of vector-borne diseases driven by transportation and climate change. In: *Emerging Pests and Vector-borne Diseases in Europe* (Editors W.Takken and B.G.J. Knols). Wageningen Academic Publishers.

Versteirt, V., Schaffner, F., Garros, C., Dekoninck, W., Coosemans, M. & Van Bortel, W. (2009) Introduction and establishment of the exotic mosquito species *Aedes japonicus japonicus* (Diptera: Culicidae) in Belgium. *Journal of Medical Entomology* **46**, 1464-1467.