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RISK ASSESSMENT AND MANAGEMENT OF MOSQUITO-BORN DISEASES IN THE EUROPEAN REGION

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Abstract The transmission of arboviruses is a major risk factor in many regions of the world including Europe. Continuing eco-climatic changes create suitable conditions for the re-emergence vector-borne diseases in Europe. Malaria was eradicated in all countries of the Region in the early 1960s except some parts of Turkey. Incidence of malaria remains relatively high in areas where malaria is endemic. The situation is complicated by the occurrence of *Plasmodium falciparum* in the bordering countries. European mosquito species and those recently introduced seams to have developed high competence for autochthonous and allochtonous viruses. Human and equine West Nile fever outbreaks have been regularly reported from the countries of southern and central Europe for almost 50 years. West Nile Virus has become a permanent expression of the European ecological and public health landscape. Some countries implemented a West Nile Virus management plan. The establishment of the European Mosquito Control Association manifests the urgent need for developing regional mosquito abatement cooperation. A chikungunya virus outbreak occurred in the region of Emilia Romagna, Italy and was vectored by *Aedes albopictus*. This was the first documented transmission of chikungunya virus at the European continent. Not only through the trade of used tires the risk of spreading the species is possible but also that a focus of *Ae. albopictus* has developed in 2007 in the Nederland. This record includes Germany in the group of 14 European countries where the species has been documented. Mosquito species responsible for pathogen transmission are in *Anopheles* and *Aedes* genera. Species belonging to *Culex* genera were believed to be "nuisance" mosquito population. However, in 2007 it was also demonstrated that in southern Europe, *Culex* species are responsible for Dirofilaria cases both in animals and humans. This evidence emphasizes the magnitude of the health importance associated to the 94 mosquito species recorded so far in Europe.
Key Words vector-borne diseases, virus transmission, vector capacity, mosquito

INTRODUCTION

No other organism influenced the social-economic development of humans more than mosquitoes. Apart from being a nuisance, bites from these insects can transmit a variety of diseases. In the past, malaria (transmitted by *Anopheles* mosquitoes) was of major importance in Europe until the eradication of the vector was completed in all countries of the Region in the early 1960s except some parts of Turkey where malaria transmission continues to persist. Moreover, sometimes in the recent past the desease began to spread again from some foci in Turkey (Mimioglu et al., 1977; Caglar and Alten, 2000). The previous statement of Hacket (1949) that endemic zones remain fixed geographically for indefinite periods owing to the constancy of the climatic and physiogeographic conditions to which the anophelinae vectors are adapted need to be revised. Never before in the history of mankind has been the impact of global climatic change more debated than at the start of the third millennium. The acceptance of the climate change is very likely the result of human activities that have lead to rising concern over how this will affect human health (WHO, 1996; McMichel, 2001; IPCC, 2007).

It has been argued that the global warming as the single cause for increased problems with arthropode-borne disease is misleading as other anthropogenic and environmental changes also contribute to the higher risk of vector transmissed pathogens (Knols and Takken, 2007). In the case of malaria well documented land use changes such as hydrological, urbanization, agricultural and forest-related impacts are having significant influence on the global burden of this disease. Gradualy, but progressively, since 1960s Europeans have become used to the absence of such threats. Decline of diseases like malaria, largely attributed to improved health care and application of insecticides for vector control, resulted in "Anophelism without malaria" when potential vectors persisted in the environment, but the parasite reservoir was eradicated (Jetten and Takken, 1994). Other diseases also present in the past in Europe, like dengue and yellow fever, used to be major threat to humans. An outbreak of infectious disease called "La Piadosa" corresponding to dengue was first recorded in 1778 in Cadiz, Spain. There is also evidence from Andalusia, South of Spain in 1927 with identical symptoms to dengue causing 5% mortality. In the period 1883-1886 dengue is present in Greece but also later, from 1927-1928 in Athens and Thessalonica when the outbreak of dengue affected 1 million people and caused 1,000 deaths. Yellow fever records go back to 1701. The first outbreak was recorded at Canary Islands. Following are severe disease outbreaks in 1705 Cadiz, 1714 Malaga, 1723 Lisbon, 1744 Balearic Islands, 1700-1800 Spanish and Portuguese coast, 1800-1880 Inner parts of Iberian Peninsula and other Mediterranean regions: France, Italy. The disease took more than 300,000 lives in Spain including 20,000 deaths in Barcelona between 1822-1824.

Regarding arboviral diseases, as mentioned dengue, and others like West Nile (WN) and Chikungunya (CHICK) viruses that originate from the African continent can no longer be considered without risk of introduction/reintroduction of vector-borne diseases. Some of them like West Nile and Chikungunya viruses have become established in the northern hemisphere. Since the start of this millennium many virus introductions have taken place in Europe. Worldwide a large number of diseases are transmitted by mosquitoes. Since 1937, when WNV was first isolated from a woman in Uganda, in the West Nile Province, and it was established that native birds are the natural reservoir in which the virus can replicate to sufficient level to allow transmission to other birds via mosquitoes, this arthropod-borne flavivirus has been endemic not only in Africa, but Europe and East Asia (Dauphin et al., 2005). Its impact has been particularly significant across the USA, Canada, Central and South America where the virus is now endemic too (Briese et al., 1999). The CHICK virus which was isolated for the first time in 1952 in Tanzania (Ross, 1956) has been having rather rapid spread and dissemination through competent vectors of some *Aedes* mosquitoes. CHICK outbreaks in 2006 in La Reunion and the latest one in 2007 in Italy once again proof that *Aedes albopictus,* known to be a competent vector of at least 22 arboviruses, include also CHIKV.

Biological invasion is not at all a current phenomenon. Every species tend to extend its range. Invasions have taken place in species of every major taxon and every trophic level into practically every terrestrial and aquatic habitat. Therefore at the European level, within the European Mosquito Control Association (EMCA) since 2000 and the European Center of Disease Prevention and Control (ECDC) since 2006 have been organized international forums and consultations for assessing the risk of both invasive mosquito species, invasive pathogens and preventing reemergence or introduction of mosquito-borne diseases into Europe.

HISTORY OF MOSQUITO CONTROL

No wonder that man is combating mosquitoes since prehistorical days. Herodotus (480 BCE) was the first in the Western World who commented on mosquito control while he was in Egypt. He described that Egyptians had two ways to avoid mosquito bites: in the Nile delta they slept under fishing nets, and in Upper Egypt on the top of towers where wind prevents mosquitoes. In the early days man used inorganic materials to combat insect pests. The Sumerians apparently used sulphur compounds to control insects well before 2500 BCE. The Chinese in 1200 BCE used plant-derived fumigants as well as mercury and arsenic compounds as insecticides (Retnakaran et al., 1985). Plinius the Elder in his *Historia Naturalis* (70 AD) includes a summary of pest control practices extracted from the Greek literature of the preceding 200-300 years. Most of the methods and materials usually based on superstition were useless. (Becker et al., 2003). The first written accounts of the application of a powder ground from the heads of pyrethrum flowers are by Boccone in 1697 and Buxbaum in 1728 who both mentioned that Asians were using local pyrethrum species (*Pyrethrum carneum* and *P. roseum*) flowers against insects. Between 1800 and 1850, pyrethrum, lime and sulphur combination, phosphorous paste and rotenone were used. Around 1870, a range of secondary plant products - nicotine, derris and quassia - were recommended. The use of arsenic Paris green and kerosene emulsion as insecticides, the era of professional application of pesticides had begun. The history of mosquito control in modern times can be divided in two eras: before and after the discovery of the role of mosquitoes in pathogen and parasite transmission by handful European and American researchers during the turn of the 20th century (Boyd, 1949). Between 1900 and 1942, mosquito control was based on two information and two basic tools: mosquitoes breed in water and they are vectors of diseases; tools to fight are the shovel and kerosene.

From the 1920s, an increasing potency of insecticides as tools for insect control led to their growing predominance as an approach to insect control (Becker et al., 2003). In 1939 the first insecticide of the chlorinated hydrocarbon group, DDT, was introduced. This was followed by the development of organophosphates and in the early fifties carbamates were created. In the era of chemical control agents, during 1960 - 1970s the development of photo stable pyrethroids led to changes in insecticide application. The adverse effects of the sometimes indiscriminated and excessive use of DDT were dramatically portrayed by the publication of Rachel Carson´s Silent Spring (1962). Inhibitors of chitin synthesis in the insect integument were developed in the early 1970s. The discoveries that insect juvenile hormones regulate many developmental functions in insects and that they are unique to arthropods, initiated the synthesis of juvenoids in the early 1980s for selective insect control. As with other alternative strategies for insect control, the full potential of juvenoids in selective and environmentally sound insect control, has not been fully realised to date.

The 1960s and 1970s numerous genetic techniques such as translocations, cytoplasmatic incompatibility, meiotic drive and sterile hybrids were investigated, but none of them became usable in wide scale. It is also important to note the extensive research on the evaluation and development of biological agents such as protozoa, fungi, nematodes, and other parasites and pathogens. So far none of these agents have emerged as widely useful tools in vector control programmes (Becker et al., 2003). Amongst these agents only two organisms, *Bacillus thuringiensis israelensis* (B.t.i.) and *B. sphaericus*, (B.s.) became wide scale used against mosquitoes due to their specific properties. Both bacilli produce protein toxins during sporulation that are concentrated in a parasporal inclusion, called the crystal. These proteins are highly toxic to mosquito larvae. Whereas B.t.i. toxins kills mosquito and black fly larvae and at higher dosages also larvae of some other nematoceran flies (Chironomidae, Sciaridae, Tipulidae), *B. sphaericus* has a more narrow host range than *B. thuringiensis israelensis* and is active only against mosquitoes and particularly active against larvae of *Culex* species and *An. gambiae*. At higher doses only larvae of Psychodidae can be affected. The potential of *B. sphaericus* lies not only in its spectrum of efficacy but also in its ability to recycle or to persist in nature under certain conditions (Becker et al., 2003). The time-span between retreatments can thus be extended and personnel costs reduced. This opens up the possibility of a successful and cost-effective control of *Culex* species, of which are some important vectors that breed primarily in highly polluted water-bodies in urban areas.

ARBOVIRUSES

There are between 500 and 600 known arthropod-borne viruses, or arboviruses, in the world, of which some 100 may give rise to disease in humans. There are four families of arboviruses: Togaviridae, Flaviviridae, Bunyaviridae and Reoviridae. By 1996, 51 arboviruses had been reported from Europe and reviewed by Hubalek and Halouzka (1996). Many of these viruses are not known to cause human illness; some have only been isolated from arthropods, birds or animals, and their public health significance is unknown. Others may cause significant human illness. Some of those that could be transmitted by mosquitoes and may have medical importance will be considered here.

West Nile Virus

West Nile virus (WNV) is a member of the genus *Flavivirus*, which also includes yellow fever and Japanese encephalitis. The virus is now known to be widely distributed across much of Africa, southern Europe, and the Middle East. In 1999, it invaded North America, and it has since spread across the country, reaching the West Coast in 2002. In that year, 3,389 reported cases of human WNV-associated illness were reported, 2 354 (69%) cases of which were West Nile meningoencephalitis. WNV was, until recently, considered relatively benign, but increasing numbers of cases of encephalitis are being seen in all areas where the virus occurs. During a large-scale outbreak in Bucharest, Romania, in 1996, of almost 1000 clinically defined cases, 393 patients with neurological disease had laboratory evidence of WNV infection. WNV is widespread in Europe and is transmitted by several species of mosquitoes. It is the cause of periodic, often severe, outbreaks in man and horses. A geographical variation exists in the status of mosquito species incriminated as vectors of WNV in Europe. Studies conducted in the Camargue, France, during WNV outbreak from 1962-1965 incriminated *Cx. modestus* as the vector (Mouchet et al., 1970). In 1969, WNV, or a virus antigenically closely related to it, was isolated from *An. maculipennis* collected in Beja, Portugal, and was named the Roxo strain. This is the first record of the isolation of an arbovirus in Portugal (Filipe, 1972). Isolations of WNV were made from *Cx. pipiens* in Romania during the outbreaks of 1996 to 2000 (Tsai et al., 1998), and this species was probably the major vector, particularly in urban areas. In the Czech Republic, WNV has been isolated from *Ae. vexans, Ae. cinereus* and *Cx. pipiens* (Hubalek et al., 2000).

The first outbreaks of WNV in France occurred in the south, in the Carmargue region, in 1962—1965. There was a high mortality rate among horses, with some 50 dying during this period (Panthier, 1968). Between 1962 and 1964, 13 human cases of WNV were reported near Montpellier and in the Carmargue, regions where *Ae. caspius* and *Cx. modestus* are common. Symptoms ranged from benign pyrexia to fatal meningoencephaltis.

Table 1. Countries in Europe in which WNV isolates have been detected (Koopmans et al., 2007)

Country	Reference	Year	Vector species
France	Hannoun et al., 1964	1964	*Culex modestus*
Russia-Volga delta	Shalunova et al., 1968	1965	
Israel	Nir et al., 1968	1968	*Anopheles coustani, Culex molestus, Culex univittatus*
Russia-Volga delta	Butenko et al., 1968	1968	
Russia	Chumakov et al., 1968	1968	
France	Mouchet et al., 1970	1970	*Culex modestus*
Russia-Volga delta	Berezin et al., 1971	1971	*Culex pipiens, Culex modestus*
Russia-Volga delta	Berezin et al., 1972	1972	*Culex univittatus, C. vishnui, C. quinquefasciatus, Coquillettidia richiardii*
Portugal	Filipe, 1972	1972	*Anopheles maculipennis*
Slovenia	Labuda et al., 1974	1974	*Ochlerotatus cantans*
Moldavia	Chumakov et al., 1974	1974	Tick spp.
Ukraine	Vinograd and Obukhova, 1974	1974	*Ochlerotatus caspius, Ochlerotatus excrusians, Ochlerotatus cantans, Anopheles maculipennis, Aedes excrusians*
Bulgaria	Katsarov et al., 1980	1980	*Culex pipiens, Coquillettidia richiardii*
Belarus	Samoilova et al., 2003	1985-1999	*Anopheles sp., Aedes sp.*
Israel	Samina et al. 1986	1986	*Culex perexiguus, Culex pipiens*
Romania	Savage et al., 1999, Tsai et al., 1998	1996	*Culex pipiens*
Czech Republic	Hubalek et al., 1998 Hubalek et al., 2000	1997-1998	*Culex pipiens*
Russia-Volga delta	L'vov et al., 2004	2000-2002	Mosquito and tick spp.?
Russia-Volga delta	L'vov et al., 2002	2001	
Russia-Volga delta	Fyodorova et al., 2006	2003	*Culex modestus, Culex pipiens*
Portugal	Estevez et al., 2005	2004	*Culex pipiens, Culex univittatus*
Israel	Mumcuoglu et al., 2005	2005	
Armenia	Manukian et al., 2006	?	*Anopheles maculipennis*

In 2000, an outbreak again occurred in the south of France in which horses were the principal victims. The most serious European outbreak of WNV occurred in Romania in 1996—1997. Seroprevalence data suggest that WNV activity in southern Romania dates to the 1960s (Campbell et al., 2001). In the 1996—1997 outbreak, 767 clinical cases of WNV were reported, with 17 deaths, representing a case fatality rate of 10%. However, it is estimated that about 70 000 (range 43,000—96,000) residents had probably been infected during the

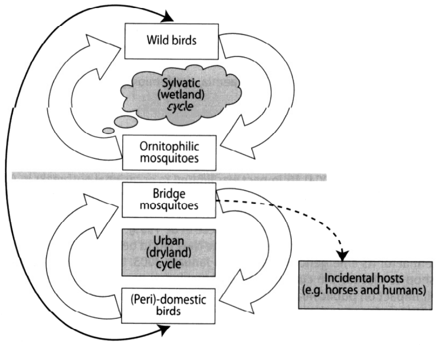

Figure 1. West Nile Virus transmission cycle (Koopmans et al., 2007)

epidemic, 0.5% of whom developed encephalitis. Following the outbreak, a surveillance system for WNV in Romania was established. The surveillance data suggest that WN virus persists focally for several years in until recently poorly understood transmission cycles (Figure 1), or that WNV is introduced into Romania at relatively high rates and persists seasonally in small foci (Ceianu et al., 2001).

The WN virus is endemic over large areas of Russian Federation and Ukraine. Platonov (2001) reviewed the status of WNV in European Russia and Siberia. WNV infection was not considered by the health authorities as a potentially emerging infection, and the large WNV outbreak in southern Russia, which started in late July 1999, was not recognized in a timely fashion. Retrospective studies of serum samples by IgM ELISA indicated WNV etiology in 326 of 463 survivors, with aseptic meningitis or encephalitis. Moreover, 35 of 56 patients who contracted aseptic meningitis in 1998 had a high titer of WNV IgG antibody. WNV infection seems to have been introduced into the Volgograd region before 1999. A complete sequence (AF317203) of WN viral RNA, isolated from the brain of one Volgograd fatality, and partial sequences of an envelope E gene from other fatal cases, showed that the Volgograd isolate had the greatest homology (99.6%) with WN-Romania-1996 mosquito strain RO97-50 (Gratz, 2003).

Dengue Virus

Dengue was at one time endemic in the countries of southern Europe in which the *Ae. aegypti* vector was present. Today, dengue is the most important arboviral human disease globally, although the disease has disappeared from Europe, mainly due to the nearly universal use of piped water supplies. Piped water has led to the disappearance of containers for the storage of water for household use and *Ae. aegypti* as a species was not reported in Europe for many years. The spread of *Ae. aegypti* in Europe is limited by its cold intolerance (Grist and Burgess 1994). Almeida reported that in the region of Madeira, Portugal, that *Ae. aegypti* is back in Portugal after 50 years of absence (Personal communication). Ryabova (2005) reported in 2005 that *Ae. aegypti* was recorded at the coast of the Black sea after many years of nonappearance. These examples and heavy invasions of *Ae. albopictus* through Europe, have to be considered since *Ae. albopictus* is a vector of dengue in some parts of the world, and strains from Albania have transmitted dengue in laboratory studies (Vazeille Falcoz et al., 1999). Dengue is frequently introduced into Europe by travelers from dengue-endemic countries, and a viremic traveler bitten by *Ae. albopictus* could be the source of dengue transmission in Europe (Ciufolini and Nicoletti, 1997).

Chikungunya Virus

CHICKV is an alphavirus of the family Togoviridae. Its natural vectors are African forest *Aedes* mosquitoes that feed preferentially on wild primates, which represent the natural hosts of the virus (Diallo et al., 1999).

Diagnosis of CHICK disease, between the outbreak periods, is rarely accomplished and the distribution of the disease is often underestimated. It has been demonstrated that the virus circulates in intertropical countries and in tropical part of Asia. The 2005-2007 outbreak occurred in Indian Ocean islands and surrounding countries: In August 2007, a Chikungunya outbreak was declared in Europe with more than 150 cases in vicinity of Ravenna in the Emilia Romanga province, Italy. The vector was *Ae. albopictus*, the species that invaded Italy in 1990 and very abundant since in the area. The virus was detected by polymerase chain reaction (PCR) in several *Ae. albopictus* pools. It is believed that the virus was introduced by a traveler who returned from South-West India where the virus was circulating.

Batai Virus (Calovo Virus)

Batai or Calovo virus, a bunyavirus, was first isolated in Europe in Slovakia from *An. maculipennis* in 1960. Batai virus, or closely related viruses, has been identified from several countries in Asia and Africa. It has been isolated as far north as Norway, Sweden, Finland and in the northern part of Russian Federation, and has been found in Ukraine, the Czech Republic, Slovakia, Austria, Hungary, Portugal, Romania, and in the south of the Russian Federation. The western European vectors are *An. maculipennis* and *An. claviger*, and it has been isolated from *Ae. communis* and other *Aedes* and *Culex* species. Lundstrom (1994, 1999) did not associate the Batai or Calovo viruses with human diseases in Western Europe, and considered their potential for human disease low. Chaporgina et al. (1995) reported a human focus of Batai virus in the Lake Baikal region. Danielova (1990) observed that Calovo virus had a very low prevalence in humans in the Czech Republic due to the marked zoophilia of its vectors.

Ockelbo Virus

Ockelbo virus is a Sindbis-related virus. It was first described in Sweden in the 1960s. In the 1980s, Ockelbo disease caused human morbidity in portions of northern Europe. In 1981, the Russian Federation and Finland reported 200 and 300 laboratory confirmed cases, respectively. A major outbreak occurred again in Finland in 1995, when 1,400 confirmed cases were reported. In Sweden, an annual average of 31 confirmed cases were diagnosed during 1981—1988, Lundstrom et al. (1991) believe that as many as 600 to 1,200 cases a year occur in the country. The virus has been isolated from *Ae. cantans, Ae. cinereus, Ae. communis, Ae. excrucians, Ae. intrudens, Cx. pipiens, Culiseta morsitans* and *Cx. torrentium,* and particularly species that feed upon the Passeriformes bird reservoirs and man. Many strains of the Sindbis group of arboviruses are widely distributed throughout Europe, Asia and Africa. They are closely related to Ockelbo and other viruses in northern Europe. The virus is maintained in nature in a mosquito-bird transmission cycle and is transmitted throughout Europe by migratory birds and ornithophilic *Culex* species and *Culiseta morsitans* as vectors (Lundstrom et al., 2001).

Inkoo Virus

Inkoo virus is a member of the California serogroup of the bunyaviruses; it is broadly distributed in northern Europe and has been reported in Norway, Sweden, Finland, Estonia and the Russian Federation. It is transmitted by *Ae. communis* and *Ae. punctor* in Scandinavia, and has been isolated from *Ae. communis* in Sweden (Francy et al., 1989). In the Russian Federation, it has been isolated from *Ae. hexodontus* and *Ae. punctor* (Mitchell et al., 1993). Inkoo virus is common in Finland, with its prevalence increasing towards the north, where it rises to 69% (Brummer and Saikku, 1975). The antibody prevalence is also high in Sweden (Niklasson and Vene, 1996), but there is no evidence of human disease caused by this virus in either country. In the Russian Federation, Demikhov (1995) noted patients with antibodies to Inkoo virus had chronic neurological disease; Demikhov and Chaitsev (1995) described severe illness ascribed to infection with the virus, although there was no mortality. Inkoo and Tahyna virus are the most common California group viruses in Eurasia, and should remain the subject of close public health surveillance.

Tahyna Virus

It is similar to Inkoo virus, but antigenically distinct (Butenko et al., 1991). It was isolated in Europe in 1958 in the present day Slovakia (Bardos and Danielova, 1959). The virus appears to be present in most countries of Europe. In human patients, the virus may present nfluenza-like symptoms, and, in some cases, meningoencephaltis and atypical pneumonia has been observed. No cases of death have been reported (Bardos, 1976). Tahyna virus is widespread in Europe and may cause severe disease, it must be considered of public health importance at present. The vectors are mainly pasture-breeding species of the genus *Aedes;* most of the isolations reported have been made from *Aedes vexans*. The anthropophilic nature of this species accounts for the high antibody rates in humans in countries where the infection is endemic in human populations. Table 2 presents a listing of countries in which Tahyna virus has been isolated or in which antibodies have been detected.

Table 2. Reports of Tahyna virus found in Europe (Gratz, 2003).

Country Results	Isolations or antibodies	Reference
Austria	*Ae. caspius*	Pilaski and Mackenstein, 1989
Croatia	Humans	Vesenjal Hirjan et al., 1989
Croatia	Bears	Madic et al., 1993
Czech Republic	*Ae. cinereus, Ae. vexans*	Danielova et al., 1977
Czech Republic	*Ae. sticticus, Cx. modestus*	Danielova and Holubova, 1977
Czech Republic	Birds	Hubalek et al., 1989
Czech Republic	Bird, swallows, martins	Jurikova et al., 1989
Czech Republic	*Ae. spp*, humans	Danilov, 1990
Czech Republic	Game animals: deer, boars	Hubalek et al., 1993
Czech Republic	Birds: cormorants	Juricova et al., 1993
Czech Republic	Birds: ducks	Juricova and Hubalek, 1993
Czech Republic	*Ae. cinereus, Ae.vexans*, humans	Hubalek et al., 1999
Czech Republic	Birds: sparrows	Juricova et al., 2000
France	*Ae. caspius*, humans	Joubert, 1975
Germany	*Ae. caspius*	Pilaski and Mackenstein, 1989
Germany	Domestic animals, humans	Knuth et al., 1990
Hungary	*Ae. caspius*	Molnar, 1982
Italy	Small mammals	Le lay Rogues et al., 1983
Poland	Birds: sparrows	Juricova et al., 1998
Portugal	Cattle and sheep	Filipe and Pinto 1969
Russian Federation	*An. hyrcanus*	L'vov, 1973
Russian Federation	Humans	Kolobukhina et al., 1989
Russian Federation	Humans	Butenko et al., 1990
Russian Federation	Humans	Glinskikh et al., 1994
Russian Federation	*Ae. communis, Ae. excrucians*	L'vov et al., 1998
Romania	*Cx. pipiens*	Arcan et al., 1974
Romania	Cattle, sheep, goats, humans	Draganescu and Girjabu, 1979
Slovakia	Humans, hares (?)	Bardos, 1976
Serbia	*Ae. vexans*	Gligic and Adamovic, 1976
Slovakia	*Ae. vexans*	Danielova et al., 1978
Slovakia	Humans	Kolman et al., 1979
Slovakia	Sheep	Juricova et al., 1986
Slovakia	*Culiseta annulata* larvae	Bardos, 1998
Spain	Rodents	Chastel et al., 1980

RISK OF IMPORTED VECTOR-BORNE DISEASES BEING ESTABLISHED

While global warming may lead to the increase and spread of existing vector-borne diseases in Europe, there are a number of infections whose importation may result in epidemic transmission in Europe due to the presence of potential vectors. The contemporary access to powerful computing models and remote sensing technology has led to numerous attempts to predict the distribution of vectors and diseases (Martens and

McMichael, 2003). Biological or empirical models that incorporate measured relationship between vector and /or pathogen development are based on correlation between spatio-temporal distributions in relation to environmental variables (statistical models) have sought to define the likelihood for establishment of vectors and the stability of the host-pathogen-vector system once in place (Campbell-Lendrum and Woodruff, 2006; Kiszewski et al., 2004). The basic reproductive rate R_o, integrates several important variables and is indicative for the absence (if <1) or presence (if >1) of the potential spread of disease (Anderson and May, 1992).

Rift Valley Fever

This disease must be considered a serious threat. Until 2000, the distribution of this serious disease was limited to the African continent. In that year, however, the virus invaded Saudi Arabia and Yemen, and it caused a serious epidemic with a high morbidity and mortality among animals and man in the first confirmed occurrence of the disease outside Africa. Statistics provided at the end of the outbreak in April 2001 from the Saudi Ministry of Health documented a total of 882 human cases with 124 deaths. The severity of the disease and the relatively high death rate (14%) may be the consequence of underreporting of the less severe disease (Balkhy and Memish, 2003). In Yemen, 1,087 cases were estimated to have occurred, with 121 deaths (Shoemaker et al., 2002). Isolations of the virus were made from two mosquito species, *Cx. tritaeniorhynchus* and *Ae. vexans arabiensis*; both species were considered as vectors on grounds of their abundance, distribution, preference for humans and sheep, isolations of virus from them, and vector competence tests (Jupp et al., 2002). *Ae. vexans* is one of the most widespread in Europe and *Cx. tritaeniorhynchus* is found in Turkey, the risk of spread to Europe is obvious.

Chikungunya Virus

In relation to Chikungunya virus, recent calculations of this latter parameter meet the values of close to 1 for southern Europe in the case of transmission by the Asian tiger mosquito *Aedes albopictus*. The establishment of this vector in southern Europe, joined with the return of virus-infected human hosts from various parts where virus circulate causes concern for an outbreak in Europe. The lesson has been already learned during August 2007 when the first outbreak of this tropical virus was recorded in Italy. This first transmission has called the attention of the competent organizations Europe wide. As a response to chikungunya virus outbreak occurred in the region of Emilia Romagna, a number of actions in a scientific community Europe wide took place. Public health experts have begun to evaluate the risk of further outbreaks and examine measures for disease prevention. The European Mosquito Control Association, through National associations provide a forum for discussion among major experts and local responsible agents. Mosquito Control Association Italy hosted International Symposium on "Risks of Chikungunya transmitted by *Aedes albopictus* and other potential vectors in Europe" in February 27, 2008.

CONCLUSIONS

The present state of art of all vector-borne diseases imply that it would be urgent that any measures would be applied to reduce and stop the progress and spread of mosquito vectors, but particularly the Asian tiger mosquito. According to all available information there is a need to point into the right direction to recognize the significance of the species, especially for the areas of recent expansion in Europe, its vector status and the control possibilities. The experts of the Forum which took place in Alessandria in February 2008 are also determined that it is extremely important to establish international projects that would contribute and lead into creation of a model for mosquito control as a major prevention of the transmission of arboviruses and all mosquito-borne diseases. This necessity is based on the latest pesticide use regulations resulting in withdrawing of insecticides for adult mosquito control within EU countries. The conventional adulticides, as a major tool in controlling vectors when it comes to outbreaks of diseases, have not been substituted by any other mean of mosquito control in the adult stage. EMCA has been persistent in encouragement of the member states to promote a better understanding of the role of mosquitoes as vectors, to enable and support further technological development of all involved as to prevent outbreak of Chikungunya and any other disease vectored by mosquitoes.

The incidence of vector-borne diseases in Europe is much greater than is generally recognized by physicians and health authorities. As a result, diagnosis and treatment are often delayed by health care professionals who are unaware of the presence of these infections and thus do not take them into consideration when attempting to determine the cause of a patient's illness. In the absence of major and dramatic outbreaks, health authorities often fail to allocate adequate funding for the surveillance and control of this group of diseases. It is important that those engaged in all aspects of public health surveillance in Europe are aware of the distribution and epidemiology of this group of diseases and are able to prepare for their control when necessary.

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