Re-Emergence of Malaria and Dengue in Europe

Rubén Bueno Marí and Ricardo Jiménez Peydró

Laboratorio de Entomología y Control de Plagas, Inst. Cavanilles de Biodiversidad y Biología Evolutiva, Universitat de València Spain

1. Introduction

Currently, the emergence/reemergence of several vector-borne diseases in Europe is one of the most important threats for Public Health. In recent years, it is well known that global change have led to drastic modifications in the eco-epidemiology of various tropical and subtropical diseases. Global change can be defined as the impact of human activity on the fundamental mechanisms of biosphere functioning. Therefore, global change includes not only climate change, but also habitats transformation, water cycle modification, biodiversity loss, synanthropic incursion of alien species into new territories or introduction of new chemicals in nature. Consequently a holistic approach is a key factor to assessing the likelihood of vector-borne diseases transmission in Europe. Among these vectors, culicid mosquitoes are probably the most important because of its large vectorial capacity and its high degree of opportunism (Table 1).

Vector species	Distribution	Indigenous/exotic	Vectorial capacity
Ae. aegypti	Madeira (Portugal), The Netherlands	Exotic (recently imported)	Dengue (DEN), Yellow Fever (YF), Chikungunya (CHIK), West Nile (WN), Japanese encephalitis (JE), Saint-Louis encephalitis (SLE), La Crosse encephalitis (LACE), Murray valley encephalitis (MVE), Western equine encephalitis (WEE), Eastern equine encephalitis (EEE), Venezuelan equine encephalitis (VEE), Myxomatosis (MYX), Avian Malaria (AMAL), Dirofilariasis (DF)
Ae. albopictus	Mediterranean area, Central Europe	Exotic (first reported in Albania in 1979)	DEN, YF, CHIK, WN, JE, SLE, LACE, WEE, EEE, VEE, Jamestown Canyon (JC), Sindbis (SIN), Tahyna (TAH), DF

Vector species	Distribution	Indigenous/exotic	Vectorial capacity
Ae. vexans	All over Europe	Indigenous	WN, TAH, Tularaemia (TU), DF
Ae. vittatus	Spain, Portugal, France, Italy	Indigenous	DEN, YF, CHIK, AMAL
An. algeriensis	Mediterranean area, Eastern Europe, Central Europe, United Kingdom	Indigenous	Malaria (MAL)
An. claviger s.l.	All over Europe	Indigenous	MAL, WN, Batai (BAT), TAH, MYX, Anaplasmosis (ANA), Borreliosis (BO), TU, DF
An. maculipennis s.l.	All over Europe	Indigenous	MAL, WN, BAT, TAH, MYX, TU, DF
An. plumbeus	All over Europe	Indigenous	MAL, WN, DF
An. sergentii	Sicily (Italy)	Indigenous	MAL
An. superpictus	Southeastern Europe	Indigenous	MAL, DF
Cx. pipiens s.l.	All over Europe	Indigenous	WN, SIN, Usutu (USU), TAH, AMAL, DF
Oc. atropalpus	Italy, France, The Netherlands.	Exotic (first reported in Italy in 1996)	WN, JE, SLE, LACE, MVE, WEE, EEE
Oc. caspius	All over Europe	Indigenous	WN, TAH, MYX, TU, DF
Oc. japonicus	France, Belgium, Switzerland, Germany	Exotic (recently imported)	WN, JEV, SLE, LACE, EEE
Oc. triseriatus	Intercepted in a batch of used tyres imported from Louisiana (USA) to France in 2004	Exotic (not yet known as established)	DEN, YF, WN, SLE, LACE, WEE, EEE, VEE, JC

Table 1. Mosquito vectors in Europe with indication of distribution, indigenous or exotic status and vectorial capacity in each case.

2. Malaria

Malaria was a widespread disease in the whole of Europe until the second half of 20th century. The anthroponosis, often called "marsh fever" in the past, was particularly devastating between XVI and XIX centuries in Southern Europe due to the boom of irrigation techniques based on long flooding periods (e.g. rice fields). Several environmental modifications (mainly the drainage of swamps, moats, ditches and other stagnant waters), but particularly the availability of efficient synthetic antimalarial drugs and improved mosquito control activities including DDT spraying after World War II, have led to the disappearance of malaria from Europe (Bruce-Chwatt & de Zulueta, 1980). However, although *Anopheles* populations were significantly reduced by different control methods, in most cases, the vectors were not eradicated.

Today malaria annually affects 500 million people and threatens directly or indirectly 40% of world population (World Health Organization [WHO], 2007). However it is well known that these morbidity and mortality data show an asymmetric distribution, mainly depending on the economical, social and sanitary level of each country or region. The disease is endemic in much of Africa and several countries of Asia, Central America and South America. In Europe, the cycles of malaria transmission are relatively common in Georgia, Azerbaijan, Kyrgyzstan, Tajikistan, Uzbekistan and Turkey (WHO, 2010). This mosquito-borne parasitaemic disease is caused by protozoa of the genus *Plasmodium*. Although the simian parasite *Plasmodium knowlesi* (Knowles and Das. Gupta 1932) has been found recently as a cause of human malaria in Southeastern Asia (Luchavez et al., 2008), other four plasmodia species are the most recognized to infect humans in nature conditions: *Plasmodium falciparum* (Welch, 1897), *Plasmodium vivax* (Grassi & Feletti, 1890), *Plasmodium malariae* (Feletti & Grassi, 1889) and *Plasmodium ovale* (Stephens, 1922). About 90% of malaria mortality is caused by tropical strains of *P. falciparum* (most pathogenic species), which is also the species of *Plasmodium* most frequently imported to Europe (European Network on Imported Infectious Disease Surveillance [TropNetEurop], 2010). Furthermore, *P. vivax* shows the largest distribution range because it may also develop in temperate climates, being consequently the only species currently present in the cycles of transmission in Europe. Finally, *P. malariae* and *P. ovale* are characterized by its narrow distribution range and low parasitemia. Regarding to malaria vectors, there are about 40 *Anopheles* species with an important role in disease transmission (Kiszewski, 2004).

2.1 Malariogenic potential of Europe

The increasing of imported malaria cases in last decades, together with the high presence of anophelines in many Southern Europe regions (Romi et al., 1997; Ponçon et al., 2007; Bueno Marí & Jiménez Peydró, 2010a), has enabled the appearance of several autochthonous malaria cases, as recently has occurred in countries like Italy (Baldari et al., 1998), Greece (Kampen et al., 2002), France (Doudier et al., 2007) or Spain (Santa-Olalla Peralta et al., 2010). This situation forces us to investigate the possible reemergence of malaria in the current context of global change. One of the best methods to deep into the knowledge of possible malaria reemergence is the study of the malariogenic potential, which can be analyzed from the study of the receptivity, infectivity and vulnerability parameters (Romi et al., 2001; Bueno Marí & Jiménez Peydró, 2008).

2.1.1 Receptivity

Receptivity could be analyzed by the presence, density, and biological characteristics of vectors. At respect, the estimation of the Vectorial Capacity (VC) is postulated as a very useful tool to assess the receptivity of a determined territory in a concrete moment (Carnevale & Robert, 2009). The VC could be estimated by the MacDonald formula (MacDonald, 1957) according to the modifications proposed by Garrett-Jones (1964):

$$VC = ma2 \, p^n \, / \, -\ln p$$

Where, m represents the relative vector density (number of vectors per man), a refers to human-biting frequency (number of human blood meals per vector and per day), p is the daily survival rate (life expectancy of the female mosquito) and n alludes to duration of the sporogonic cycle (length in days of the latent period of the parasite in the mosquito, i.e. extrinsic incubation cycle). It is important to note that ma is usually measured by collecting mosquitoes during an entire night using human bait. Consequently VC could be defined as the future daily sporozoite inoculation rate arising from a currently infective human case, on the assumption that all female mosquitoes biting that person become infected (Githeko, 2006). Of course VC changes from site to site, from vector to vector, and within and between transmission seasons.

2.1.1.1 Malaria receptivity in Southern Europe

Because of climatic conditions, the Southern Europe represents the territory of the Old Continent where disease cycles can be completed more likely. In terms of receptivity, of twenty species of *Anopheles* described in Europe twelve are confined in its distribution to Southern areas (Table 2). In the Iberian Peninsula rice cultivation was clearly associated with malaria endemicity until the beginning of the 20th century (Cambournac & Hill, 1938; Cambournac, 1939, Blázquez, 1974; Bueno Marí & Jiménez Peydró, 2010b). In these larval biotopes the species *Anopheles atroparvus* and, to a much lesser extent and only in the more arid areas, *Anopheles labranchiae* were supposed to be the major malaria vectors (Bruce-Chwatt & de Zulueta, 1977), although some other species, such as *Anopheles maculipennis* or *Anopheles claviger* may locally also have contributed to disease transmission (Bueno Marí, 2010). Currently *An. atroparvus* remains widespread in rice fields and other potential *Anopheles* breeding sites of Portugal and Spain (Capinha et al. 2009; Sainz-Elipe et al. 2010), since the most important western Mediterranean malaria vector *An. labranchiae* is considered dissapeared. *An. labranchiae* was found to be abundant in a restricted area of the contiguous Alicante and Murcia Provinces (South-eastern Spain) in 1946 (Clavero & Romeo Viamonte, 1948), but had disappeared by 1973 (Blázquez & de Zulueta, 1980) probably due to abandonment of rice cultivation in this area (Eritja et al., 2000). Recent surveys carried out in this area have revealed again the absence of *An. labranchiae* as well as high populations of the secondary vector *Anopheles algeriensis* also characterized by high domiciliation degrees (Bueno Marí, 2011). This was the only area where *An. labranchiae* has been able to establish itself in the Iberian Peninsula (Blázquez & de Zulueta, 1980). Though abundant along the African coastline between Ceuta and Tangiers, *An. labrachiae* has been unable to obtain a toe-hold in 15 km distant coastal plains of southern Spain, where rice fields support large populations of *An. atroparvus* (Ramsdale & Snow, 2000). It is important to note that the most important vector of the Iberian Peninsula *An. atroparvus* is suspected of being the vector of an autochthonous case of *Plamodium vivax* which recently occurred in Northeastern Spain (Santa-Olalla Peralta et al., 2010) and even also in other case of *Plamodium ovale* which happened in Central Spain, although airport malaria cannot be discarded in this last case due to the proximity of the patient's residence to two international airports (Cuadros et al., 2002).

Anopheles Species	European distribution	Malaria outbreaks
An. algeriensis	Brit, Ire, Fra, Cors, Spain, Bala, Port, Ger, Aust, Ital, Sard, Sic, Croa, Alb, Gree, Turk, Hung, Bulg, Moldv, Ukr, EurRus, Est	Argelia (non demonstrated vector in Europe)
An. atroparvus	Brit, Ire*, Swe, Den, Fra, Spain, Port, Belg, Neth, Ger, Aust, Czech, Slovk, Pol, Switz[a], Ital, Ser-Mon, Croa, Bosn, Slovn, Mace, Hung, Rom, Bulg, Moldv, Ukr, Bela, EurRus, Lith, Latv	Northern Europe, Central Europe, Eastern Europe, Mediterranean Europe
An. beklemishevi	Swe, Fin, EurRus	-
An. cinereus	Spain, Port	-
An. claviger	Brit, Ire, Nor, Swe, Den, Fra, Cors, Spain, Port, Belg, Neth, Lux, Ger, Aust, Czech, Slovk, Pol, Switz, Ital, Sic, Ser-Mon, Croa, Bosn, Slovn, Mace, Alb, Gree, Turk, Cypr, Hung, Rom, Bulg, Moldv, Ukr, Bela, EurRus, Lith, Latv, Est	Eastern Mediterranean countries, Central Asia
An. daciae [b]	Brit, Rom	-
An. hyrcanus	Fra, Cors, Spain, Ital, Sard, Sic, Ser-Mon, Croa, Mace, Alb, Gree, Turk, Hung, Rom, Bulg, Moldv, Ukr, EurRus	Asia (as An. hyrcanus s.l.)
An. labranchiae	Cors, Ital, Sard, Sic, Croa	France (Corsica), Italy (Peninsular Italy, Sardinia and Sicily), Southeastern Spain (disappeared since 1973)
An. maculipennis	Nor, Swe, Den, Fra, Cors, Spain, Port, Belg, Neth, Lux*, Ger, Aust, Czech, Slovk, Pol, Switz[a], Ital, Sic, Ser-Mon, Croa, Bosn, Slovn, Mace, Alb, Gree, Turk, Hung, Rom, Bulg, Moldv, Ukr, Bela, EurRus, Lith, Latv, Est	Coastal areas in the Balkans, Asia Minor, Northern Iran
An. marteri	Cors, Spain, Port, Ital, Sard, Sic, Alb, Gree, Turk, Bulg	-
An. melanoon [c]	Fra, Cors, Spain, Ital, Rom, EurRus	-
An. messeae	Brit, Ire[a], Nor, Swe, Den, Fra, Cors, Belg, Neth, Ger, Aust, Czech, Slovk, Pol, Switz[a], Ital, Ser-Mon, Croa, Bosn, Slovn, Mace, Alb, Gree, Hung, Rom, Bulg, Moldv, Ukr, Bela, EurRus, Lith, Latv, Est	Eastern Europe

An. multicolor	Spain	-
An. petragnani	Fra, Cors, Spain, Port, Ital, Sard, Sic	-
An. plumbeus	Brit, Ire, Swe, Den, Fra, Cors, Spain, Port, Belg, Neth, Lux, Ger, Aust, Czech, Slovk, Pol, Switz, Ital, Sic, Ser-Mon, Croa, Bosn, Slovn, Mace, Alb, Gree, Turk, Hung, Rom, Bulg, Ukr, Bela, EurRus, Lith, Est	England, Germany, Caucasus
An. pulcherrimus [d]	Turk	Middle East
An. sacharovi	Cors, Ser-Mon, Croa, Mace, Alb, Gree, Turk, Bulg, EurRus	Near East
An. subalpinus [c]	Fra, Cors, Port, Ser-Mon, Croa, Mace, Alb, Gree, Turk, Bulg, EurRus	Albania, Greece
An. sergentii	Sic	Mediterranean Africa
An. superpictus	Cors, Ital, Sic, Ser-Mon, Croa, Mace, Alb, Gree, Turk, Bulg, EurRus	Middle East

Note 1: Countries with anophelines records considered as doubtful or sporadic were not included. If it is thought that the species has been eradicated, the country is also not listed. *Note 2*: Brit (Britain), Ire (Ireland), Nor (Norway), Swe (Sweden), Den (Denmark), Fra (France), Cors (Corsica), Spain, Bala (Balearic Islands), Port (Portugal), Belg (Belgium), Neth (Netherlands), Lux (Luxemburg), Ger (Germany), Aust (Austria), Czech (Czech Republic), Slovk (Slovakia), Pol (Poland), Switz (Switzerland), Ital (Italy), Sard (Sardinia), Sic (Sicily), Malt (Malta), Ser-Mon (Serbia-Montenegro), Croa (Croatia), Bosn (Bosnia), Slovn (Slovenia), Mace (Macedonia), Alb (Albania), Gree (Greece), Turk (Turkey), Cypr (Cyprus), Hung (Hungary), Rom (Romania), Bulg (Bulgaria), Moldv (Moldavia), Ukr (Ukraine), Bela (Belarus), EurRus (Eropean Russia), Lith (Lithuania), Latv (Latvia), Est (Estonia).
[a] Records referred to *Anopheles maculipennis* s.l.
[b] Species recently described by molecular and morphological techniques.
[c] There is confusion with these two species.
[d] Present in Asiatic Turkey.

Table 2. *Anopheles* species with endemic presence in Europe and indication of historical data about its vectorial role (Ramsdale & Snow, 2000; Schaffner et al., 2001; Beck et al., 2003; Nicolescu et al., 2004; Linton et al., 2005; Becker et al., 2010; European Mosquito Taxonomists [MOTAX], 2010).

In France, the same two species mentioned above for the Iberian Peninsula, are also considered to be primary malaria vectors because of their abundance and their potential anthropophily: *An. atroparvus* in continental France and *An. labranchiae* in Corsica. In a former malaria-endemic area of Southern France, intensive samplings conducted recently in rice fields showed that *Anopheles hyrcanus* seems to be the only potential vector likely to play a role in malaria transmission in view of its abundance and anthropophily (Ponçon et al., 2007). Since 1994 several cases of vivax and falciparum malaria with no history of international travels, blood transfusion or injection drug use have been reported in Southern France (Delmont et al., 1994; Baixench et al., 1998; Doudier et al., 2007). In Corsica, where *An. labranchiae* still present in high densities in different regions (Toty et al., 2010), autochthonous *P. vivax* malaria transmission has been diagnosed, probably via the bite of a local *Anopheles* mosquito infected with *P. vivax* from a patient who had acquired infection in Madagascar (Armengaud et al., 2006). The second most important malaria vector of Corsica, *Anopheles sacharovi*, has not been detected in the island since 2002 (Toty et al., 2010).

Until the beginning of dichlorodiphenyltrichloroethane (DDT) application, the main malaria vectors in Italy were *An. superpictus* as well as two species of the *Anopheles maculipennis* complex: *An. labranchiae* and *An. sacharovi* (Hackett & Missiroli 1935). Despite *An. labranchiae* used to breed in various types of waters, such as marshes, streams, small pools or irrigation channels, the rice fields established in the 1970s currently represent its most important larval habitats in Central Italy (Bettini et al., 1978; Romi et al., 1992). Even in Western province of Grosseto *An. labranchiae* has replaced *Anopheles melanoon*, species that in 1970 represented for 100% of the anophelines fauna (Majori et al., 1970). Precisely in Grosseto region occurred the last autochthonous malaria case in Italy in August 1997 (Baldari et al., 1998). Nowadays of the anopheline species that have been vectors of malaria in Italy, only *An. labranchiae* and *An. superpictus* are still present in epidemiologically relevant densities (Romi et al., 1997). Moreover *An. atroparvus* is also present in Italy at low densities and *An. sacharovi* is currently considered disappeared, since last specimens of the vector were found 50 years ago (Sepulcri, 1963).

In Balkan countries (Bulgaria, Romania, Croatia, Serbia, Bosnia-Herzegovina, Montenegro and Albania, among others) the species *An. sacharovi* used to be the main malaria vector in coastal areas while *An. superpictus* and *An. maculipennis* were the primary vectors in inland areas due to the specific adaptations of their preimaginal stages (Hackett, 1937; Hadjinicolaou & Betzios, 1973; Bruce-Chwatt & de Zulueta, 1980). Larvae of *An. sacharovi* are tolerant against brackish water but not against salt water. On the other hand *An. superpictus* breeds in slowly flowing waters in hilly areas while *An. maculipennis* breeds in stagnant inland waters (Jetten & Takken, 1994). However, when sporadically *An. maculipennis* has colonized coastal areas of Balkans, Asia Minor and Northern Iran, it has also showed an important role in malaria transmission (Postiglione et al., 1973; Zaim, 1987; Manouchehri et al., 1992; Schaffner et al., 2001). Of the three most important vectors of Balkans, *An. superpictus* was never collected in Romania. Therefore in this country in addition to *An. sacharovi* and *An. maculipennis*, also *Anopheles messeae* and *An. atroparvus* have contributed to the endemism of malaria. Generally *An. messeae* has played a prominent role as a malaria vector in the Danube Valley and Delta, while *An. maculipennis* was mainly responsible for malaria transmission in the Romanian plains and *An. sacharovi* and *An. atroparvus* have been primary vectors at the Black Sea coast (Zotta, 1938; Zotta et al., 1940; Ciuca, 1966). All these issues represent the concept of "malaria stratification", which indicates a good relation between the distribution of the different anophelines species and the great "malaria geographic lines" (Nicolescu, 1996). Moreover a new species of the *An. maculipennis* complex, named *Anopheles daciae*, was recently first described in Romania (Nicolescu et al., 2004). It seems likely that *An. daciae* could be widespread in Eastern Europe and the Balkan States, and also could be responsible for malaria transmission in these regions that is currently attributed to *An. messeae*.

In order of relevance, *An. sacharovi*, *An. superpictus* and *An. maculipennis* were considered the main malaria vectors in Greece (Belios, 1955, 1978). During the recent years several autochthonous cases of *P. falciparum*, *P. malariae* and *P. vivax* have been diagnosed in Northern Greece (Kampen et al., 2002). At respect, it is important to note the proximity of this region to an unstable malaria country as Turkey. In Turkey malaria is still one of the most important vector-borne diseases in Turkey (Kasap et al., 2000; Alten et al., 2003), even remaining some endemic areas with hundreds of vivax cases yearly. The most important vectors in Turkey are *An. sacharovi* and *An. superpictus* (Kuhn et al., 2002), taking *An. maculipennis*, *An. claviger* and *Anopheles hyrcanus* a secondary role in malaria transmission.

If we analyze the VC of European anophelines we can extract several conclusions. In Spain the populations of *An. atroparvus* were deeply studied by several authors basically during the endemic period (Buen de, 1931, 1932; Buen de & Buen de, 1930, 1933; Torres Cañamares, 1934; Olavarria & Hill, 1935; Lozano Morales, 1946; Zulueta de, 1973; Blázquez, 1974). The estimation of VC shows that *An. atroparvus* was an important malaria vector in different wetlands of Spain mainly during summer months. The VC was especially high for *P. vivax* (in August VC=0.7–21.2) which has a shorter sporogonic cycle than *P. falciparum* (in August VC=0.2-5.3). In September VC values were lower for both *P. vivax* (VC=0.2–9.2) and *P. falciparum* (VC=0.04-2.3) and in October VC values were drastically reduced, but still relevant in the case of *P. vivax* (VC *P. vivax*=0.01-2.1 / VC *P. falciparum*=0.00007-0.02) (Bueno Marí & Jiménez Peydró, 2012). These results are similar to others derivates from different entomological researches carried out in Italy more recently. During August 1994 in Tuscany (Grosseto Province) were reported for *An. labranchiae* VC values ranging from 8.3-32.5 for *P. vivax* and 7.3-26 for *P. falciparum* (Romi et al., 1997). However VC was very low in early July, constituting no real risk for malaria transmission (<0.01 for both *P. vivax* and *P. falciparum*). Subsequently during 1998 in the same province but in areas where only natural anopheline breeding sites were reported, the VC of *An. labranchiae* from mid-July through the end of August ranged from 0.96-3.3 for *P. vivax* and 0.8-2.9 for *P. falciparum* (Romi, 1999). In other Mediterranean areas (North of Morocco), VC of *An. labranchiae* for *P. vivax* also showed high values during summer months (in July VC=17.2; in August=34; in September=18.3), while values from April to June were lower ranging from 0.5-3.7 (Faraj et al., 2008). On the other hand the average VC of *An. sacharovi* was found to be 0.22 (VC ranging from 0.63-0.014) in an endemic area of Southeastern Turkey (Tavşanoğlu & Çağlar, 2008). These last low VC values were probably related with very low percentages of human blood meals by anophelines.

Accordingly, although of course all these values of VC are purely theoretical, it is important to note that can be numerically shown that summer (from July to September, but especially in August) is an excellent season for malaria transmission, at least at receptivity level, in Southern Europe.

2.1.1.2 Malaria receptivity in Northern Europe

Endemic northern malaria reached to 68°N latitude in Europe during the 19th century, where the summer mean temperature only irregularly exceeded 16°C. It is important to note that precisely 16°C is considered the lower limit needed for sporogony of *P. vivax* (Garnham, 1988). In Finland *Anopheles beklemishevi* has a northern distribution, while the other common species, *An. messeae*, is dominant in the southern part of the country (Gutsevich et al., 1974; Lokki et al., 1979; Kettle, 1995). Both species are known as an important malaria vectors (White, 1978). Despite other potential vectors, such as *An. claviger* and *An. maculipennis* have been observed (Utrio, 1979; Dahl, 1997), it is not possible to define certainly which mosquito species was most important for the malaria transmission in Finland. This is because temperature conditions of Finland, as well as in other northern countries, should have caused that malaria transmission have mainly occurred in indoor conditions due to transmission of sporozoites throughout the winter by semiactive hibernating mosquitoes (Huldén et al., 2005), since it is well known that in warm conditions the overwintering females of *Anopheles* can take several blood meals (Ekblom & Ströman, 1932; Encinas Grandes, 1982). Therefore, the best malaria vectors in Northern Europe will be those anthropophilic and endophagic anophelines which present hibernating females with

semiactive winter habits but not a complete diapause. In conclusion, northern malaria existed in a cold climate by means of summer dormancy of *P. vivax* hypnozoites in addition to the indoor feeding activity of overwintering *Anopheles* females previously mentioned.

In other Scandinavian countries such as Sweden or Denmark, besides the anophelines which has been mentioned above, there have been described other potential malaria vectors: *An. atroparvus* and *Anopheles plumbeus* (Ramsdale & Snow, 2000). Although *An. messeae* was probably the main vector during the malaria epidemics in Sweden, some authors proposed that *An. atroparvus* may have maintained malaria endemicity in certain coastal localities in the south of the country (Jaenson et al., 1986). Regarding to *An. plumbeus* there are several aspects that should be pointed to understand the increasing epidemiological importance of the species in Central Europe. *An. plumbeus* is the only hole breeding species of the genus *Anopheles* in Europe. Although it is a strictly dendrolimnic species, during dry periods females can also lay the eggs in small domestic and peridomestic containers, as well as other artificial breeding sites below the ground such as catch basins and septic tanks with water contaminated with organic waste (Bueno Marí & Jiménez Peydró, 2011). There are several reports in Europe about the presence of larvae in a biotope different from the tree cavity (Aitken, 1954; Senevet et al., 1955; Rioux, 1958; Tovornik, 1978; Bueno Marí & Jiménez Peydró, 2010a). Moreover, remarkable populations can also be found in urban situations, where the larvae develop in tree holes in gardens and parks, especially in Central Europe where *An. plumbeus* has increased in numbers during the last decades and can be a major nuisance species (Becker et al., 2010). This is a very important issue, because the continuous development of this species in urban environments could increase considerably the possibilities of interaction between malaria vectors and humans. In fact, *An. plumbeus* has been suspected to be responsible for two recorded cases of locally transmitted malaria in London, United Kingdom (Blacklock, 1921; Shute, 1954) and other two cases recently reported in Duisburg, Germany (Krüger et al., 2001). Of the five *Anopheles* species present in Britain only two, *An. atroparvus* and *An. plumbeus*, have been confirmed as malaria vectors in United Kingdom (James, 1917; Shute, 1954), while *An. messae* and *An. atroparvus* were the vectors involved in vivax epidemics occurred in Germany during the 20th Century (Kirchberg & Mamlok, 1946).

Therefore, it exists in Europe a latitudinal gradient in relation to the distribution of the species of the *An. maculipennis* complex. Without ignoring the possible participation of several species in malaria transmission cycles, the fact is that in Northern Europe (including European Russia) at 68ºN *An. beklemishevi* prevails as vector, being this species replaced by *An. messae* partially at 63ºN and fully about 59ºN. Around 56ºN *An. atroparvus* begins to acquire an important role in disease transmission and already in Mediterranean countries the situation of malaria receptivity is basically governed by *An. atroparvus*, *An. labranchiae* and *An. sacharovi* in Eastern, Central and Western Mediterranean respectively. As was previously pointed, this situation can be locally modified by the presence of other potential vectors widely distributed in Europe such as *An. claviger*, *An. hyrcanus*, *An. maculipennis* or *An. plumbeus*. Of course climate change could drastically modify not only the distribution of European anophelines, but also their phenology and overwintering patterns. However the changes in agricultural practices have a greater effect on the risk of malaria than an elevation in temperature of approximately 2°C (Becker, 2008), which is considered the average increasing temperature in Europe in next 50 years. Hence habitat modification is probably the factor with more influence in possible changes in malaria receptivity all over Europe.

2.1.2 Infectivity

Infectivity is defined as the degree of susceptibility of *Anopheles* mosquitoes to different *Plasmodium* species, i.e. refers to the possibilities that the sporogonic cycle of parasite could be completed within a concrete vector species. It is well known that mosquito populations of the same species but different geographic areas can differ drastically at infectivity level due to genetic reasons (Frizzi et al., 1975).

Infectivity tests carried out on European populations of species of the *An. maculipennis* complex showed that *An. atroparvus* can transmit Asian strains of *P. vivax* and African strains of *P. ovale* but is refractory to African strains of *P. falciparum* (James et al., 1932; Garnham et al., 1954; Ramsdale & Coluzzi, 1975; Teodorescu, 1983; Ribeiro et al., 1989). However, more recent studies have shown the ability of *An. atroparvus* to generate oocysts of *P. falciparum* (Marchant et al., 1998), but not to complete sporogony. Information about *An. labranchiae* is quite confusing due to the scanty and old infectivity tests conducted. Moreover laboratory studies have revealed that *An. labranchiae* can transmit *P. ovale* (Constantinescu & Negulici, 1967) but populations of the vector collected in Italy were refractory to African strains of *P. falciparum* (Ramsdale & Coluzzi, 1975; Zulueta de et al., 1975). Nevertheless recent researches with populations from Corsica have indicated that *P. falciparum* cycle can be successfully completed in *An. labranchiae* (Toty et al., 2010). Furthermore *An. labranchiae* has been involved in transmission of autochthonous vivax malaria cases and in Corsica (France), Greece and Italy (Sautet & Quilici, 1971; Zahar, 1987; Baldari et al., 1998) and even several outbreaks of *P. falciparum*, *P. malariae* and *P. vivax* in Morocco (Houel & Donadille, 1953). Under laboratory conditions, *An. sacharovi* has been demonstrated as an excellent vector of *P. vivax* (Kasap, 1990) and *An. messeae* was reported, not only as being the main vector of malaria over a large part of European Russia several decades ago (Detinova, 1953), but also the responsible of disease resurgence in Russia and Ukraine more recently (Nikolaeva, 1996). With regard to *An. maculipennis* it is known that in certain coastal areas in the Balkans, Asia Minor and Northern Iran (Postiglione et al., 1973; Zaim, 1987; Manouchehri et al., 1992), the species has participated actively in malaria transmission cycles. Due to its recent description, *An. daciae* yet must be tested on its susceptibility to *Plasmodium* species

Outside the species of the *An. maculipennis* complex is remarkable that European populations of *An. plumbeus* can produce sporozoites of tropical strains of *P. falciparum* (Marchant et al., 1998; Eling et al., 2003), as well as also Eurasiatic strains of *P. vivax* (Shute & Maryon, 1974). Even some authors suggest that *An. plumbeus* is capable of transmitting the four Plasmodium species (Shute & Maryon, 1969). However this hypothesis should be confirmed with modern molecular techniques. Respect to *An. algeriensis* and *An. claviger*, it is important to note that in natural populations it has been shown the presence of oocysts of *P. vivax* at intestinal level (Blacklock & Carter, 1920; Horsfall, 1972). In the case of *An. algeriensis*, even has been successfully tested the transmission of *P. falciparum* in laboratory conditions (Becker et al., 2010). *An. superpictus* can transmit *P. vivax* (Kasap, 1990) but its susceptibility to *P. falciparum* has not been tested, although this anopheline is probably sensitive, as it belongs to the subgenus *Cellia*, to which the principal African malaria vectors also belong. Another species of the subgenus *Cellia* poorly represented in Europe, such as *Anopheles multicolor* and *Anopheles sergentii*, have been also found parasitized by *P. vivax* and *P. falciparum* in natural conditions (Kenawy et al., 1990). Finally, there is no infectivity information about *An. marteri*, *An. cinereus* and *An. petragnani*. Anyway the epidemiological role of these species it seems secondary due to their zoophylic behaviour and rural distribution.

2.1.3 Vulnerability

Vulnerability is determined by the number of gametocyte carriers (malaria patients) during the suitable period for malaria transmission. If we analyze the data about imported malaria in Europe in recent years we can extract several conclusions. Malaria represents about 77% of tropical diseases imported in Europe (TropNetEurop, 2010). A total of 65.596 cases were reported in Europe between 2000 and 2009 (Table 3). However this number is clearly underestimated, since in last years the number of malaria reporting sites in Europe has increased significantly. Most of these cases are referred to immigrants (48.5%), and *P. falciparum* (81%) was the dominant species in analytic results. A high percentage of malaria cases in immigrants correspond to Visiting Friends and Relatives (VFR). This group of special epidemiological significance refers to those people who, once are established in their host countries, often travel to their origin countries to visit family or friends. Travels that these people can do to their origin countries exponentially increase the chances of disease contracting, since usually these areas are endemic regions and the stay within resident population and their customs is often long and intense (Gascón, 2006). Therefore this is an important collective to promote the need to take appropriate prophylactic measures during travels to endemic areas. Several studies have revealed that only 16% of VFR search for medical advice pre-travel, being malaria prophylaxis practically nonexistent in this collective (Leder et al., 2006). The European countries with higher number of imported malaria cases reported yearly are France and Germany, usually followed by other like Spain, Italy or Belgium. As it was shown before, malaria receptivity is remarkable in concrete regions of these countries.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Cases (sites reporting)	1120 (32)	3313 (38)	4555 (47)	5561 (44)	6536 (47)	7411 (50)	8544 (50)	8904 (52)	9509 (57)	10.143 (59)	65.596
P. falciparum	78.4%	70.0%	77.6%	82.4%	81.2%	81.6%	87.8%	82.8%	83.9%	84.0%	81%
P. vivax	11.5%	13.9%	11.7%	10.4%	11.2%	10.2%	7.5%	8.3%	8.2%	8.6%	10.1%
P. ovale	5.2%	5.3%	3.4%	3.1%	3.5%	4.4%	2.8%	4.3%	3.9%	3.1%	3.9%
P. malariae	2%	5.9%	4.3%	1.5%	1.5%	1.7%	1%	1.2%	1.5%	2.3%	2.3%
Unkn./Coinf.	2.9%	4.9%	3.1%	2.7%	2.4%	2.2%	0.9%	3.4%	2.7%	4.4%	2.7%
Imm./Refu.	30.5%	35.4%	44.8%	50.2%	54%	54.6%	52.8%	50.8%	55.2%	56.7%	48.5%
For. Vis.	11.8%	14.6%	7.5%	9.1%	7%	9.2%	10.3%	3.3%	5.1%	9.2%	8.7%
Eur. E.C.	53.8%	44.4%	38.9%	30.6%	30%	26.1%	26.2%	35.2%	34%	26.4%	34.5%
Eur. Exp.	3.9%	5.6%	8.8%	11.1%	9%	10.1%	10.7%	10.7%	5.7%	7.7%	8.3%

Note 1: Unkn./Coinf. (Plasmodium species unknown or coinfection of various species), Imm./Refu. (Immigrants/Refugees), For. Vis. (Foreign Visitors), Eur. E.C. (Europeans living in EC), Eur. Exp. (European Expatriates).

Table 3. Imported malaria in Europe between 2000-2009 (TropNetEurop, 2010).

The temporal distribution analysis of imported malaria cases indicates that high-risk months for disease transmission (between July and September) also coincides with the period of the most cases reported in Europe. Therefore most of cases occur during the epoch theoretically favorable for malaria transmission. In regard to the diagnostic delay, i.e. the average time between appearance of symptoms and malaria diagnosis (when therapy began), it shows disparate values according to each country. For example, in Eastern Spain the diagnostic delay of imported malaria was estimated in 13.7 days (Bueno Marí & Jiménez Peydró, 2012), while in other European countries like Sweden, France or Italy values are clearly lower, ranging from 3 to 8.2 days (Romi et al., 2001; Askling et al., 2005; Chalumeau et al., 2006). From an epidemiological point of view it is very important to reduce the diagnostic delay, because this is the period when malaria patients could be a source of infection for *Anopheles* females. Additionally, from an exclusively clinical perspective, delay to diagnosis leads of course to high parasitemia, which itself leads to severe forms of malaria.

3. Dengue fever and yellow fever

There are many similarities between dengue fever and yellow fever:

- Both are viruses of the genus Flavivirus (family Flaviviridae) and are strictly primatophilic, infecting only primates, including man.
- In their original habitat, both are zoonotic infections transmitted by forest mosquitoes.
- Their importance as human pathogens can be related with two forest mosquitoes characterized by high ecological plasticity that have become closely associated with the peridomestic environment.
- Both diseases have a history of transmission in temperate regions, including Europe, and share essentially the same selvatic and urban vectors.
- Transovarian transmission in female mosquitoes has been demonstrated for both viruses.
- The viruses and their urban vectors have a worldwide distribution due to transportation of goods and people.
- Both arboviruses are characterized by short incubation period and can provoke similar clinical symptoms, including hemorrhagic illness in humans, often with fatal consequences. However mortality rate is higher in yellow fever (20%) than in dengue (5%).

In the case of dengue fever its annual incidence has increased dramatically around the world in recent decades. It is estimated that over 2500 millions people who live in over 100 tropical and non-tropical countries, are currently at risk from dengue viruses globally. The rise in dengue incidence has been marked by geographic expansion of the virus and the vectors due to globalization, habitat modifications, lack of effective mosquito control programs and climate change. Although the major disease burden occurs in South East Asia, the Americas and the western Pacific, dengue was also a common disease in Europe in the past centuries. Large epidemics of dengue and yellow fever occurred in European ports of Spain, Portugal, France, Italy and even Wales and Ireland as the more northern countries of the continent (Eager, 1902; Monath, 2006). Last dengue epidemic in Europe, estimated at one million cases, occurred in Greece in 1927-28 (Papaevangelou & Halstead, 1977; Rosen, 1986).

Dengue is the most frequent tropical arboviruses imported in Europe and together with schistosomiasis both are considered, after malaria, the most important tropical diseases in

quantitative terms in Old continent. Of the hundreds of dengue imported cases reported yearly en Europe (Table 4), the vast majority are represented by tourists (about 84%). A difference to what happens with malaria, immigration (9%) seems to have comparatively little influence on dengue importation. This could be explained, of course by distinct perspectives and approaches of European tourists (e.g. travels to urbanized areas) and immigrants who come to Europe (e.g. Africa, where malaria is much prevalent than dengue, is the main origin from immigrants who arrive to Europe), but also by differences between incubation periods and existing prophylactic measures in both diseases. All dengue cases reported have shown the typical symptomatology of disease, including febrile symptoms in more than 90% of cases (TropNetEurop, 2010). However, it is important to note that the majority of imported dengue infections remain undiagnosed, with a ratio between symptomatic and asymptomatic travelers estimated in 1/3.3 (Cobelens et al., 2002). In general terms, it is estimated that about 80% of all dengue infections are asymptomatic (Farrar, 2008). This high asymptomatic, added to the fact that dengue is not a notifiable disease in much of European countries (Bueno Marí & Jiménez Peydró, 2010c; 2010d), allow us to consider that the knowledge of dengue virus circulation is very limited.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Cases (sites reporting)	477 (37)	664 (47)	742 (46)	852 (48)	1023 (51)	1167 (50)	1273 (53)	1419 (57)	1553 (61)	9170
Imm./Refu.	10%	5.5%	8.2%	12.9%	6.8%	10.5%	9%	6.8%	11.3%	9%
For. Vis.	0.8%	0.5%	1%	0%	1.2%	4.8%	2.2%	0.8%	2.4%	1.5%
Eur. E.C.	86.7%	91.3%	79.6%	81.9%	87.7%	77.1%	81.3%	87.3%	83.9%	84.1%
Eur. Exp.	2.5%	2.7%	11.2%	5.2%	4.3%	7.6%	7.5%	5.1%	2.4%	5.4%

Note 1: Imm./Refu. (Immigrants/Refugees), For. Vis . (Foreign Visitors), Eur. E.C. (Europeans living in EC), Eur. Exp. (European Expatriates).

Table 4. Imported dengue in Europe between 2001-2009 (TropNetEurop, 2010).

Aedes aegypti is the primary urban vector of dengue and yellow fever basically because it exist a 'domesticated' form of the species that is rarely found more than 100 m from human habitation and feeds almost exclusively on human blood (Reiter, 2010). Both factors allow that *Ae. aegypti* will be considered as an excellent urban vector of viruses. Its distribution was traditionally limited by latitude between 45º N and 35º S according to the existence of January and July 10° C isotherms. Although records out of this latitude range are very rarely, it must be pointed that European northernmost collection of the species occurred in Brest (France) at 48º N (Christopher, 1960). Moreover recent studies have demonstrated that *Ae. aegypti* larvae can withstand temperatures of 2.5° C (Chang et al., 2007). In Eastern Europe it was also seen at its temperature limit at Odessa (Ukraina) at 46º N. (Korovitzkyi and Artemenko, 1933). Despite the species was relatively common in Mediterranean countries, it disappeared from the entire region in the mid-20th century, for reasons that currently are not clear but probably related with thermic tolerance and intensive mosquito

control campaigns with the employment of DDT. *Ae. aegypti* was common in the Iberian Peninsula mainly introduced from North Africa and was present in this Southern European region up to 1956 (Ribeiro & Ramos, 1999). Since the eradication of the species in Europe, its sporadic presence has been recognized in several countries, namely Britain, France, Italy, Malta, Croatia, Ukraine, Russia and Turkey (Snow & Ramsdale, 1999). However it must be pointed that the species has been reported in Madeira (Portugal) in 2005 (Margarita et al., 2006) and it seems that *Ae. aegypti* is now deeply established in this region because of continuous collections in later years (Almeida et al., 2007). This is the first report of the establishment of the species in Europe since mid-20th century. More recently *Ae. aegypti* has been also captured in The Netherlands (Scholte et al., 2010). In summary, we must pay some attention to surveillance and behavior of *Ae. aegypti* because globalization is provoking the arrival of the species to Europe and global warming could allow the definitive establishment of the species again in Southern areas.

On the other hand the situation is clearly divergent in regard to the secondary vector of dengue and yellow fever, *Aedes albopictus*, usually known as Asian tiger mosquito, due to its quick expansion in Europe in last years. There are several ecological factors that can help us to understand the different importance of *Ae. aegypti* and *Ae. albopictus* as primary and secondary vectors of human viruses respectively. Unlike patterns of oviposition and feeding exhibited by *Ae. aegypti*, Asian tiger mosquito is often abundant in the peridomestic environment, particularly in areas with plentiful vegetation, and feeds freely on humans and other animals. Consequently *Ae. albopictus* can also exist far from human habitation. Additionally *Ae. aegypti* has been globally dispersed from Africa by humans activities since several centuries ago while *Ae. albopictus* was firstly report out of its original Asiatic distribution range in 1979 in Albania (Adhami & Reiter, 1998). Current data indicate that *Ae. albopictus* has been detected much farer north than *Ae. aegypti* and one major difference between both species is that Asian tiger mosquito has the ability to adapt to cold temperatures by becoming dormant during the winter of temperate regions. The ability of *Ae. albopictus* to resist cold temperatures is partially related with its ability to synthesize a high amount of lipids, especially to produce larger amounts of yolk lipid in cold temperatures. At respect, it was demonstrated that larval lipogenesis of *Ae. albopictus* is much more efficient than that of *Ae. aegypti* (Briegel & Timmermann, 2001). Although *Ae. albopictus* occurs in both temperate and tropical areas, only temperate population, but not tropical ones, show a photoperiodic diapauses (Hawley, 1988). During the shortening daylight hours in late summer/early autumn, the reduced photoperiod stimulates the females of *Ae. albopictus* to produce eggs that enter facultative diapause (Estrada-Franco & Craig 1995). These eggs can resist hatching stimuli until the following spring and remain in a state of reduced morphogenesis as fully formed first instar larvae, exhibiting increased resistance to environmental extremes. Although the diapause occurs in the egg stage, only adults and pupae are known to be photoperiodically sensitive stages (Wang, 1966; Imai & Maeda, 1976; Mori et al, 1981).

Ae. albopictus has been found to be capable to transmit 26 viruses (Moore & Mitchell, 1997; Gratz, 2004; Paupy et al., 2009) and to be experimentally susceptible to several filariasis of veterinary interest (Cancrini et al., 1995; Nayar & Knight, 1999). Globalization has allowed the arrival of this species to Europe, mainly through the transport of eggs and larvae in used tires and gardening products (Reiter & Sprenger, 1987; Madon et al., 2002). The presence of Asian tiger mosquito has been confirmed in 16 European countries, but only in Southern ones the species is deeply established. Particularly interesting is the situation of Italy, where

the species was firstly detected in 1990 (Sabatini et al., 1990) and nowadays has colonized more than 2/3 parts of the territory, even having different areas of the country with mosquitoes densities in considerable epidemiological levels. Precisely these locally high densities have allowed the appearance of first cases of human viruses in Europe transmitted by *Ae. albopictus*. Specifically, in the province of Ravenna (Northeastern Italy) occurred an outbreak of Chikungunya virus in 2007. This virus is very similar to dengue and yellow fever (same vectors, bioecology and symptomatology), but much less pathogenic. Just in two and a half months, a total of 205 cases of Chikungunya were reported in two small towns of Ravenna where the infection of *Ae. albopictus* was also confirmed (Rezza et al., 2007). This outbreak of Chikungunya infection, outside a tropical country, was probably begun by a man from India, country that previous year had suffered an epidemic with more than 1 million cases (Ravi, 2006). The Indian man developed a febrile syndrome two days after his arrival in Italy and also had high titres of antibodies against Chikungunya. The phylogenetic analysis showed that the strain that caused Italian outbreak was similar to the strains detected on the Indian subcontinent (Yergolkar et al., 2006), showing in all cases a better adaption to *Ae. albopictus* than other variants. However most worrying scenario took place in 2010 with the re-appearance of first autochthonous cases of dengue in Europe transmitted by *Ae. albopictus*. In this year, two cases of autochthonous dengue fever were diagnosed in Nice (Southeast France) (La Ruche et al., 2010), region where *Ae. albopictus* is established at least since 2004 (Delaunay et al., 2007). Just days after two indigenous cases of Chikungunya in the districts of Alpes-Maritime and Var (also in Southeastern France) were detected through a routinely surveillance of dengue and Chikungunya (ECDC, 2010), which is yearly conducted since 2006 due to the establishment of *Ae. albopictus* in this region. In Greece, other Mediterranean country where *Ae. albopictus* is established at least since 2004 (Klobucar et al., 2006), two cases of indigenous dengue were diagnosed also in 2010 (Schmidt-Chanasit et al., 2010; Gjenero-Margan et al., 2011). The identification of these cases of dengue fever and Chikungunya occurred in 2010, which were in all cases well clustered in space and time, is strongly suggestive that autochthonous transmission of tropical viruses in Europe is ongoing.

According to these epidemiological perspectives it seems evident that there is a need to be able to predict the potential distribution and activity of *Ae. albopictus* in Europe to asses about possible re-emergence of dengue and other tropical arboviruses. At respect several Geographic Information Systems (GIS) have been developed in order to predict the number of weeks of activity of *Aedes albopictus* (ECDC, 2009). These GIS models have revealed that throughout much of Europe, more than 23 weeks are predicted to elapse between egg hatching in spring (in response to at least 11.25 hours of daylight and 10.5° C of mean temperature) and adult die-off in autumn (below critical temperature threshold of 9.5° C). Assuming that immature development takes about 2–4 weeks, this constitutes more than 20 weeks of adult activity in Central Europe and Southern United Kingdom, even increasing this activity to more than 40 weeks in southern areas (mainly Greece, Turkey and south of Iberian and Italic Peninsula), depending on availability of surface water for breeding. If these predictions would be fulfilled in Southern Europe, consequently could increase the speed of spread of the species, could also extend the episodes of medical and social alerts derivates from its feeding behavior in urban areas, and even could change the eco-epidemiology of viruses that *Ae. albopictus* can transmit.

It must be pointed that *Ae. albopictus* and *Ae. aegypti* are not the only aedine vectors with invasive behavior in Europe. Other exotic mosquitoes, such as *Ochlerotatus japonicus* and

Ochlerotatus atropalpus, have been also reported. *Oc. japonicus* is an Asian species and a competent vector of several arboviruses, including West Nile virus and Japanese encephalitis virus and is considered a significant public health risk (Sardelis & Turell, 2001; Sardelis et al., 2002a; 2002b; 2003). *Oc. japonicus* has been collected only in France, Belgium, Switzerland and Germany (Schafther et al., 2003; 2009; Becker et al., 2011). On the other hand *Oc. atropalpus* is endemic to North America and has been observed in Italy, France and Netherlands (Romi et al., 1997; Adege-EID Méditerranée, 2006; Scholte et al., 2009). Although in the field, *Oc. atropalpus* has not been evidenced as an important vector of infectious diseases, under laboratory conditions, the species has been proven as a competent vector for West Nile virus, Japanese encephalitis virus, Saint-Louis encephalitis virus La Crosse encephalitis virus, among other arboviruses (King, 1960; Turell et al., 2001). Globalization, especially traffic of used tires, has led the arrival of *Oc. japonicus* and *Oc. atropalpus* to Europe. Out of these exotic vectors, we can not forget or ignore the presence of potential indigenous vectors of dengue and yellow fever in Europe. For example, *Aedes vittatus* is an important vector of yellow fever in different parts of Africa (Lewis, 1943; Satti & Haseeb, 1966) and also a potential vector of Chikungunya and four dengue serotypes (Mourya & Banerjee, 1987; Mavale et al., 1992). Although the species is deeply distributed in Mediterranean region (Spain, Portugal, France and Italy), the studies about its biology and phenology have been scanty in Europe. Anyway it seems unlikely that *Ae. vittatus* could start a cycle of virus transmission to humans because of its high degree of ruralism. Moreover *Ochlerotatus geniculatus* is a dendrolimnic species endemic to Europe that can efficiently transmit yellow fever, but this possibility has been evidenced only in laboratory conditions (Roubaud et al., 1937).

3.1 New challenges: The development of dengue vaccines

Although a vaccine based on live attenuated virus of the strain 17D is available for yelow fever since years, currently we haven´t any vaccine to be used with full warranty against dengue. However, the need for a dengue vaccine is clear. The most effective measures of an integrated mosquito control program (including changes in human habitation and behavior, the use of insecticides, and long-lasting modification of natural and man-made mosquito habitats) are difficult to implement and largely unsuccessful in most poverty-stricken settings, and consequently have not been carried out comprehensively enough to limit dengue's spread. While vector control is an integral part of any dengue prevention strategy, it is not enough on its own.

In recent years it has been obtained a better understanding of the disease and its etiopatogenicity, as well as of the necessary aspects to develop a vaccine that provides an effective and lasting protection against the virus. Dengue vaccine development is a very difficult task due to the possible participation of four related serotypes, since immunity to one serotype does not confer immunity to the remaining three. Complicating the scenario further is immune enhancement, which can result in severe dengue hemorrhagic fever or dengue shock syndrome in anyone who has been infected with one of the serotypes and subsequently becomes infected with another. Most of researchers agree that only effective solution is a tetravalent vaccine that simultaneously protects against all four serotypes. Regarding to this, it must be noted that tetravalent vaccines against dengue are currently in last phases of trials and is expected to be available for human population in the next following years.

4. Conclusions

Although malaria's receptivity is still high in different parts of Europe, we may conclude that the malariogenic potential of the Old Continent is low. Fortunately socio-economic and sanitary conditions of most European countries also support this assertion. While it is true that infectivity studies should be further promoted, percentages of imported malaria cases remain very low. However we must pay some attention to the increasing trend of malaria importation in last years, as well as also awareness among tourists and VFR's for to take corresponding prophylactic measures during their travels to endemic areas. Anyway, sporadic and local cases of autochthonous transmission mainly transmitted by *An. atroparvus, An. labranchiae, An. sacharovi* and/or *An. plumbeus*, can not been discarded in next years.

On the other hand, the answer to the question about if should be expected the re-emergence of dengue and other mosquito-borne tropical viruses in Europe in next years is indubitable: definitively yes. The arrival, establishment and expansion of dengue urbanite vectors due to global changes such as globalization, climate change and the lack of effective mosquito control programs, together with the increasing of imported cases in humans provokes that local and intense transmission of dengue could be a reality in next years in Southern Europe. To cope this possibility is necessary to enhance the entomological surveillance in potential areas of mosquitoes importation, such as airports or seaports, strength the monitoring of tropical viruses imported and awareness among citizens about their role in mosquito control and best prophylactic measures to take during the travels to tropical regions.

5. Acknowledgments

6. References

Adege-EID Méditerranée. (2006). *Éléments entomologiques relatifs au risque d'apparition du virus Chikungunya en métropole* . Entente interdépartementale pour la démoustication du littoral (EID) Méditerranée, Montpellier, France.

Adhami, J.R. & Reiter, P. (1998). Introduction and establishment of *Aedes (Stegomyia) albopictus* Skuse (Diptera: Culicidae) in Albania. *Journal of American Mosquito Control Association*, Vol.14, No.3, (September 1998), pp. 340-343, ISSN 1046-3607.

Aitken, T.G.H. (1954). The Culicidae of Sardinia and Corsica (Diptera). *Bulletin of Entomological Research*, Vol.45, No.3, (September 1954), pp. 437-494, ISSN 0007-4853.

Almeida, A.P.; Gonçalves, Y.M.; Novo, M.T.; Sousa, C.A.; Melim, M. & Gracio AJ. (2007). Vector monitoring of *Aedes aegypti* in the Autonomous Region of Madeira, Portugal. *Euro Surveillance*, Vol.12, No.46, (November 2007), ISSN 1560-7917, Available online in: http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=3311

Alten, B.; Çağlar, S.S.; Şimşek, F.M. & Kaynas, S. (2003). Effect of insecticide-treated bednets for malaria control in Southeast Anatolia - Turkey. *Journal of Vector Ecology*, No.28, Vol.1, (June 2003), pp. 97-107, ISSN 1081-1710. Date of submission:

Armengaud, A.; Legros, F.; Quatresous, I.; Barre, H.; Valayer, P.; Fanton, Y.; D' Ortenzio, E. & Schaffner, F. (2006). A case of autochthonous *Plasmodium vivax* malaria, Corsica, August 2006. *Euro Surveillance*, Vol.11, No.46, (November 2006), ISSN 1560-7917, Available online in:
https://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=3081

Askling, H.H.; Ekdahl, K.; Janzon, R.; Henric Braconier, J.; Bronner, U.; Hellgren, U.; Rombo, L. & Tegnell, A. (2005). Travellers returning to Sweden with falciparum malaria: pre-travel advice, behaviour, chemoprophylaxis and diagnostic delay. *Scandinavian Journal of Infectious Diseases*, Vol.37, No.10, (October 2005), pp. 760-765, ISSN 0036-5548.

Baixench, M.T.; Suzzoni-Blatger, J.; Magnaval, J.F.; Lareng, M.B. & Larrouy, G. (1998). Two cases of inexplicable autochthonous malaria in Toulouse, France. *Medecine tropicale : revue du Corps de sante colonial*, Vol.58, No.1, (January 1998), pp. 62–64, ISSN 0025-682X.

Baldari, M.; Tamburro, A.; Sabatinelli, G.; Romi, R.; Severini, C., Cuccagna, P.; Fiorilli, G.; Allegri, M.P.; Buriani, C. & Toti, M. (1998). Introduced malaria in Maremma, Italy, decades after eradication. *The Lancet*, Vol.351, No.9111, (April 1998), pp. 1246-1248, ISSN 0140-6736.

Beck, M.; Galm, M.; Weitzel, T.; Fohlmeister, V.; Kaiser, A.; Arnold, A. & Becker, N. (2003). Preliminary studies on the mosquito fauna of Luxembourg. *European Mosquito Bulletin*, Vol.14, (January 2003), pp. 21-24. ISSN 1460-6127.

Becker, N. (2008). Influence of climate change on mosquito development and mosquito-borne diseases in Europe. Parasitology Research, Vol.103, No.1, (January 2008), 103:19–28, ISSN 0932-0113.

Becker, N.; Petric, D.; Zgomba, M.; Boase, C.; Madon, M.; Dahl, C. & Kaiser, A. (2010). *Mosquitoes and Their Control*. 2 nd ed. Springer, ISBN 978-3-540-92873-7, Berlin, Deutschland.

Becker, N.; Huber, K.; Pluskota, B. & Kaiser, A. (2011). Ochlerotatus japonicus japonicus – a newly established neozoan in Germany and a revised list of the German mosquito fauna. *European Mosquito Bulletin,* Vol.29 (April 2011), pp. 88-102, ISSN 1460-6127.

Belios, G.D. (1955). Recent course and current pattern of malaria in relation to its control in Greece. *Rivista di Malariologia*, Vol.34, pp. 1-24, ISSN 0370-565X.

Belios, G.D. (1978). From malaria control to eradication: problems and solutions. *Archeion Hygiene Athens*, Vol.27, pp. 54-59.

Bettini, S.; Gradoni, L.; Cocchi, M. & Tamburro, A. (1978). Rice culture and *Anopheles labranchiae* in Central Italy. WHO unpublished document, WHO/MAL 78.897, WHO/VBC series 78.686, Geneva, Switzerland.

Blacklock, B. (1921). Notes on a case of indigenous infection with *P. falciparum*. *Annals of Tropical Medicine and Parasitology*, Vol.15, pp. 59-72, ISSN 0003-4983.

Blacklock, B. & Carter, H.F. (1920). The experimental infection in England of *Anopheles plumbeus*, Stephens, and *Anopheles bifurcatus*, L., with *Plasmodium vivax*. *Annals of Tropical Medicine and Parasitology*, Vol.13, No.4, (March 1920), pp. 413-420, ISSN 0003-4983.

Blázquez, J. (1974). Investigación entomológica sobre anofelismo en el delta del Ebro. *Revista de Sanidad e Higiene Pública,* Vol.48, No.4 (April 1974), pp. 363-377, ISSN 0034-8899.

Blázquez, J. & Zulueta de, J. (1980). The disappearance of *Anopheles labranchiae* from Spain. *Parassitologia,* Vol.22, No.1-2, (January 1980), pp. 161-163, ISSN 0048-2951.

Briegel, H. & Timmermann, S.E. (2001). *Aedes albopictus* (Diptera: Culicidae): physiological aspects of development and reproduction, *Journal of Medical Entomology*, vol.38, No.4, (July 2001), pp. 566–571, ISSN 0022-2585.

Bruce-Chwatt, L.J. & Zulueta de, J. (1977). Malaria eradication in Portugal. *Transactions of the Royal Society of Tropical Medicine and Hygiene,* Vol. 71, No.3, (March 1977), pp. 232-240, ISSN 0035-9203.

Bruce-Chwatt, L.J. & Zulueta de, J. (1980). *The Rise and Fall of Malaria in Europe*. Oxford University Press, ISBN 978-0198581680, New York, USA.

Buen de, E. (1931). Algunos estudios sobre biología del *Anopheles maculipennis* en lo que se refiere a la casa habitada por el hombre o animales. *Medicina de los Países Cálidos*, Vol.4, (September 1931), pp. 400-414.

Buen de, E. (1932). Algunos datos sobre la biología del *A. maculipennis* (*claviger*) en su fase de adulto. *Medicina de los Países Cálidos*, Vol.5, (November 1932), pp. 449-485.

Buen de, S. & De Buen, E. (1930). Notas sobre la biología del *A. maculipennis. Medicina de los Países Cálidos*, Vol.3, (September 1930), pp. 1-17.

Buen de, S. & Buen de, E. (1933). El *Anopheles maculipennis* y la casa; sus relaciones con la epidemiologia del paludismo en España. *Medicina de los Países Cálidos*, Vol.6, (July 1933), pp. 270-299.

Bueno Marí, R. (2011). El anofelismo en la Comunidad Valenciana: un ejemplo de estudio del potencial malariogénico de España. *Boletín de la Asociación española de Entomología*, Vol.35, No.1-2 (June 2011), pp. 47-83, ISSN 0210-8984.

Bueno Marí, R. (2010). *Bioecología, diversidad e interés epidemiológico de los culícidos mediterráneos (Diptera, Culicidae)*. Servei de Publicacions de la Universitat de València, ISBN 978-84-370-7987-5, Valencia, Spain.

Bueno Marí, R. & Jiménez Peydró, R. (2008). Malaria en España: aspectos entomológicos y perspectivas de futuro. *Revista Española de Salud Pública,* Vol.82, No.5, (September 2008), pp. 467-489, ISSN 1135-5727.

Bueno Marí, R & Jiménez Peydró, R. (2010a). New anopheline records from the Valencian Autonomous Region of Eastern Spain (Diptera: Culicidae: Anophelinae). *European Mosquito Bulletin,* Vol.28, (September 2010), pp. 148-156, ISSN 1460-6127.

Bueno Marí, R. & Jiménez Peydró, R. (2010b). Crónicas de arroz, mosquitos y paludismo en España: el caso de la provincia de Valencia (s. XVIII-XX). *Hispania* Vol.70, No.236, (September 2010), pp. 687-708, ISSN 0018-2141.

Bueno Marí, R. & Jiménez Peydró, R. (2010c). Situación actual en España y eco-epidemiología de las arbovirosis transmitidas por mosquitos culícidos (Diptera: Culicidae), Vol.84, No.3, (May 2010), pp. 255-269, ISSN 1135-5727.

Bueno Marí, R. & Jiménez Peydró, R. (2010d). ¿Pueden la malaria y el dengue reaparecer en España?, Vol.24, No.4, (July 2010), pp. 347-353, ISSN 0213-9111.

Bueno Marí, R & Jiménez Peydró, R. (2012). Study of the Malariogenic Potential of Eastern Spain. *Tropical Biomedicine,* in press.

Bueno Marí, R & Jiménez Peydró, R. (2011). *Anopheles plumbeus* Stephens, 1828: a neglected malaria vector in Europe. *Malaria Reports,* Available online in: http://www.pagepressjournals.org/index.php/malaria/article/view/malaria.2011.e2. ISSN 2039-4381.

Cambournac, F.J.C. (1939). A method for determining the larval *Anopheles* population and its distribution in rice fields. *Rivista di Malariologia* Vol.18, pp. 17-22, ISSN 0370-565X.

Cambournac, F.J.C. & Hill, R.B. (1938). The Biology of *Anopheles maculipennis* var. *atroparvus* in Portugal. *Transactions of 3rd International Congress of Tropical Medicine & Malaria*. Vol.2, pp. 178-184.

Cancrini, G.; Pietrobelli, M.; Frangipane di Regalbono, A.F.; Tampieri, M.P. & della Torre, A. (1995). Development of *Dirofilaria* and *Setaria* nematodes in *Aedes albopictus*. *Parassitologia,* Vol. 37, No.2-3, (December 1995), pp. 141–145, ISSN: 0048-2951.

Capinha, C.; Gomes, E.; Reis, E.; Rocha, J.; Sousa, C.A.; Rosário, V.E.; Almeida, A.P. (2009). Present habitat suitability for *Anopheles atroparvus* (Diptera, Culicidae) and its coincidence with former malaria areas in mainland Portugal. *Geospatial Health* Vol.3, No.2, (May 2009), pp. 177-187, ISSN 1827-1987.

Carnevale, P. & Robert, V. (2009). *Les anophèles: Biologie, transmission du Plasmodium et lutte antivectorielle*, Bondy, IRD, ISBN 978-2-7099-1662-2, Montpellier, France.

Chalumeau, M.; Holvoet, L.; Chéron, G.; Minodier, P.; Foix-L'Hélias, L.; Ovetchkine, P.; Moulin, F.; Nouyrigat, V.; Bréart, G. & Gendrel, D. (2006). Delay in diagnosis of imported *Plasmodium falciparum* malaria in children. *European Journal of Clinical Microbiology & Infectious Diseases*, Vol.25, No.3, (March 2006), pp. 186-189, ISSN 0934-9723.

Chang, L.H.; Hsu, E.L.; Teng, H.J. & Ho C.M. (2007). Differential survival of *Aedes aegypti* and *Aedes albopictus* (Diptera: Culicidae) larvae exposed to low temperatures in Taiwan. *Journal of Medical Entomology*, vol.44, No.2, (March 2007), pp. 205-210, ISSN 0022-2585.

Christopher, S.R. (1960). *Aëdes aegypti (L.) the yellow fever mosquito, its life history, bionomics and structure*, Cambridge University Press, New York, United States of America..

Ciuca, M. (1966). *L'eradication de Paludisme en Roumanie*. Editions Medicales, Bucarest, Romania.

Clavero, G. & Romeo Viamonte, J.M. (1948). EI paludismo en las huertas de Murcia y Orihuela. Ensayos de aplicación de los insecticidas modernos, D.D.T. y 666, en la lucha antipalúdica. *Revista de Sanidad e Higiene Pública* Vol. 22, pp. 199-228, ISSN 0034-8899.

Cobelens, F.G.; Groen, J.; Osterhaus, A.D.; Leentvaar-Kuipers, A.; Wertheim-Van Dillen, P.M. & Kager, P.A. (2002). Incidence and risk factors of probable dengue virus infection among Dutch travellers to Asia. *Tropical Medicine and International Health*, Vol.7, No.4, (April 2002), pp. 331-338, ISSN 1360-2276.

Constantinescu, P. & Negulici, E. (1967). The experimental transmission of *Plasmodium malariae* to *Anopheles labranchiae atroparvus*. *Transactions of the Royal Society of Tropical Medicine and Hygiene,* Vol.61, No.2, pp. 182-188, ISSN 0035-9203.

Cuadros, J.; Calvente, M.J.; Benito, A.; Arévalo, J.; Calero, M.A.; Segura J. & Rubio, J.M. (2002). *Plasmodium ovale* Malaria acquired in Central Spain. *Emerging Infectious Diseases*, Vol.8, No.12, (December 2002), pp. 1506-1508, ISSN 1080-6040.

Dahl, C. (1997). *Diptera Culicidae, Mosquitoes*. In: *Aquatic Insects of northern Europe-A Taxonomic Handbook*. Vol.II, Nilsson, A.N. (Eds.), 163-186, Apollo Books, ISBN 8788757552, Stenstrup, Denmark.

Delaunay, P.; Mathieu, B.; Marty, P.; Fauran, P. & Schaffner, F. (2007). Historique de l' installation *d'Aedes albopictus* dans les Alpes-Maritimes (France) de 2002 à 2005. *Medecine tropicale*, Vol.67, No.3, (June 2007), pp. 310-311. ISSN 0025-682X.

Delmont, J.; Brouqui, P.; Poullin, P. & Bourgeade, A. (1994). Harbour-acquired *Plasmodium falciparum* malaria. *The Lancet*, Vol.344, No. 8918, (July 1994), pp. 330–331, ISSN 0140-6736.

Detinova, T.S. (1953). Age composition and epidemiological importance of the population of Anopheles maculipennis in the Province of Moscow. *Meditsinskaya Parazitologiya i Parazitarnie Bolezni*, Vol.22, pp. 486-495.

Doudier, B.; Bogreau, H.; De Vries, A.; Ponçon, N.; Stauffer, W.M. & Fontenille, D. (2007). Possible autochthonous malaria from Marseille to Minneapolis. *Emerging Infectious Diseases*, Vol.13, No.8, (August 2007), pp. 1236-1238, ISSN 1080-6059.

Eager JM. (1902). Yellow fever in France, Italy, Great Britain and Austria and bibliography of yellow fever in Europe. *Yellow Fever Institute Bulletin*, Vol.8, pp. 25-35.

European Center of Disease Control (ECDC). *EWRS Message: ID: 20100924FR0001*. 2010, Accessed 14th March 2011 Available online in:
https://ewrs.ecdc.europa.eu/Pages/Secure/Messages/ViewMessage.aspx?id=201 00924FR0001

European Center of Disease Control (ECDC). *Development of Aedes albopictus risk maps*. 2009, Accessed 14th March 2011 Available online in:
http://ecdc.europa.eu/en/publications/Publications/0905_TER_Development_of _Aedes_Albopictus_Risk_Maps.pdf

Ekblom, T. & Ströman, R. (1932). Geographical and biological studies of *Anopheles maculipennis* in Sweden from an epidemiological point of view. *Kungliga Svenska Vetenskapsakademiens handling,* Vol.11, No.1, pp. 1-113.

Eling, W.; Van Gemert, G.J.; Akinpelu, O.; Curtis, J. & Curtis, C.F. (2003). Production of *Plasmodium falciparum* sporozoites by *Anopheles plumbeus*. *European Mosquito Bulletin*, Vol.15, (June 2003), pp. 12-13, ISSN 1460-6127.

Encinas Grandes, A. (1982). *Taxonomía y biología de los mosquitos del área salmantina (Diptera, Culicidae)*, Universidad de Salamanca, ISBN 8400050673, Salamanca, Spain.

Eritja, R.; Aranda, C.; Padrós, J.; Goula, M.; Lucientes, J.; Escosa, R.; Marquès, E. & Cáceres, F. (2000). An annotated checklist and bibliography of the mosquitoes of Spain (Diptera: Culicidae). *European Mosquito Bulletin*, Vol.8, (November 2008), pp. 10-18, ISSN 1460-6127.

Estrada-Franco, J.G. and Craig, G.B. (1995). *Biology, disease relationships, and control of Aedes albopictus*, Pan American Health Organization, ISBN 9275130426, Washington, United States of America.

European Mosquito Taxonomists (MOTAX). *Chart of European Mosquitoes*. 2010, Accessed 14th March 2011 Available online in: http://www.sove.org/motax/chart.htm

European Network on Imported Infectious Disease Surveillance (TropNetEurop). *Friend and observers Sentinel Surveillance Report.* 2010, Accessed 14th March 2011 Available online in:
http://www.tropnet.net/reports_friends/reports_friends_index.html

Faraj, C.; Ouahabi, S.; Adlaoui, E.; Boccolini, D.; Romi, R. & El Aouad, R. (2008). Risque de réémergence du paludisme au Maroc étude de la capacité vectorielle d'*Anopheles*

labranchiae dans une zone rizicole au nord du pays. *Parasite*, Vol.15, No.4, (December 2008), pp. 605–610, ISSN 1252-607X.

Farrar, J. (2008). *Clinical features of dengue*. In: *Dengue*, Halstead, S.B. (Ed.), 171-191, Imperial College Press, ISBN: 978-1-84816-228-0, London, United Kingdom.

Frizzi, G.; Rinaldi, A. & Bianchi, L. (1975). Genetic studies on mechanisms influencing the susceptibility of Anopheline mosquitoes to plasmodial infections. *Mosquito News*, Vol.35, No.4, (December 1975), pp. 505-508, ISSN 0027-142X.

Garnham, P.C.C.; Bray, R.S.; Cooper, W.; Lainson, R.; Awad, F.I. & Williamson, J. (1954). Pre-erythrocytic stages of human malaria: *Plasmodium ovale*. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, Vol.49, No.1, (January 1954), pp. 158-167, ISSN 0035-9203.

Garnham, P.C.C. (1988). *Malaria parasites of man: life-cycles and morphology (excluding ultrastructure).* In *Malaria: principles and practice of malariology*, Wernsdorfer W.H. & McGregor, I. (Ed), Vol. I, 61-96, Churchill Livingstone, ISBN 0443024170, Edinburgh, United Kingdom.

Garrett-Jones, C. (1964). Prognosis for Interruption of Malaria Transmission Through Assessment of the Mosquito's Vectorial Capacity. *Nature* Vol.204, (December 1964), pp. 1173-1175, ISSN 0028-0836.

Gascón, J. (2006). Paludismo importado por inmigrantes. *Anales del Sistema Sanitario de Navarra*, Vol.29, No.1, (January 2006), pp. 121-125, ISSN 1137-6627.

Githeko, A.K. (2006). *Entomological correlates of epidemiological impacts: how do we know it is working?* In: *Bridging Laboratory and Field Research for Genetic Control of Disease Vectors*, Knols, B.G.J., Louis, C. & Bogers, R.J. (Eds.), 215-219, Springer, ISBN 1-4020-3799-6, Dordrecht, Netherlands.

Gjenero-Margan, I.; Aleraj, B.; Krajcar, D.; Lesnikar, V.; Klobučar, A.; Pem-Novosel, I.; Kurečić-Filipović, S.; Komparak, S.; Martić, R.; Đuričić, S.; Betica-Radić, L.; Okmadžić, J.; Vilibić-Čavlek, T.; Babić-Erceg, A.; Turković, B.; Avšić-Županc, T.; Radić, I.; Ljubić, M.; Šarac, K.; Benić, N. & Mlinarić-Galinović, G. (2011). Autochthonous dengue fever in Croatia, August–September 2010. *Euro Surveillance*, Vol.16, No.9, (March 2011), ISSN 1560-7917, Accessed 14th March 2011, Available online in:
http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=19805

Gratz, N.G. (2004). Critical review of the vector status of *Aedes albopictus*. *Medical and Veterinary Entomology*, Vol.18, No.3, (September 2004), pp. 215–227, ISSN 0269-283X.

Gutsevich, A.V.; Monchadskii, A.S. & Shtakelberg, A.A. (1974). *Fauna of the USSR. Diptera. Mosquitoes. Family Culicidae.* Vol.3, No.4., Keter Publishing House Jerusalem Ltd, ISBN 7065 1475, Jerusalem, Israel.

Hackett, L.W. (1937). *Malaria in Europe: An Ecological Study*. Oxford University Press, London, United Kingdom.

Hackett, L.W. & Missiroli, A. (1935). The varieties of *Anopheles maculipennis* and their relation to the distribution of malaria in Europe. *Rivista di Malariologia*, Vol.14, pp. 45-109, ISSN 0370-565X.

Hadjinicolaou, J. & Betzios, B. (1973). Resurgence of *Anopheles sacharovi* following malaria eradication. *Bulletin of the World Health Organization*, Vol.48, No.6, pp. 699-703, ISSN 0042-9686.

Hawley, W.A. (1988). The biology of *Aedes albopictus*. *Journal of the American Mosquito Control Association*, Vol.4, No.1, (March 1988), pp. 1–39, ISSN 1046-3607.

Horsfall, W.R. (1972). *Mosquitoes: their bionomics and relation to disease*. Hafner, New York, United States of America.

Huldén, L.; Huldén, L. & Heliövaara, K. (2005). Endemic malaria: an 'indoor' disease in northern Europe. Historical data analysed. *Malaria Journal*, Vol.4, No.4, (April 2005), ISSN 1475-2875, Accessed 14th March 2011 Available online in: http://www.malariajournal.com/content/4/1/19

Imai, C. & Maeda, O. (1976). Several factors effecting on hatching on *Aedes albopictus* eggs. *Japanese Journal of Sanitary Zoology*, Vol.27, pp. 363-372, ISSN 0424-7086.

Jaenson, T.G.T.; Lokki, J.; Saura, A. (1986). *Anophele*s (Diptera: Culicidae) and malaria in Northern Europe, with special reference to Sweden. *Journal of Medical Entomology*, Vol.23, No.1, (January 1986), pp. 68-75, ISSN 0022-2585.

James, S.P. (1917). Note recording the proof that *Anopheles maculipennis* is an efficient host of the benign tertian malaria parasite in England. *Journal of the Royal Army Medical Corps*, Vol.29, pp. 615, ISSN 0035-8665.

James, S.P.; Nicol, W.D. & Shute, P.G. (1932). *P. ovale* passage through mosquitoes and successful transmission by their bites. *Annals of Tropical Medicine and Parasitology*, Vol.26, pp. 139-145, ISSN 0003-4983.

Jetten, T.H. & Takken, W. (1994). *Anophelism Without Malaria in Europe: A review of the ecology and distribution of the genus Anopheles in Europe*. Wageningen Agricultural University Papers, Wageningen, The Netherlands, ISBN 906754373X.

Kampen, H.; Maltezos, E.; Pagonaki, M.; Hunfeld, K.P.; Maier W.A. & Seitz, H.M. (2002). Individual cases of autochthonous malaria in Evros Province, northern Greece: serological aspects. *Parasitology Research,* Vol.88, No.3, (March 2002), pp. 261-266, ISSN 0932-0113.

Kasap, H. (1990). Comparison of experimental infectivity and development of *Plasmodium vivax* in *Anopheles sacharovi* and *An. superpictus* in Turkey. *American Journal of Tropical Medicine and Hygiene*, Vol.42, No.2, (February 1990), pp. 111-117, ISSN 0002-9637.

Kasap, H.; Kasap, M.; Alptekin, D.; Lüleyap, U. & Herath, P.R.J. (2000). Insecticide resistance in *Anopheles sacharovi* Favre in southern Turkey. *Bulletin of the World Health Organization*, Vol.78, No.5, pp. 686-692, ISSN 0042-9686.

Kenawy, M.A.; Beier, J.C.; Asiago, C.M.: Said el S.E. & Roberts C.R. (1990). Interpretation of low-level Plasmodium infection rates determined by ELISA for anophelines (Diptera: Culicidae) from Egyptian oases. *Journal of Medical Entomology*, Vol.27, No.4, (July 1990), pp. 681-685, ISSN 0022-2585.

Kettle, D.S. (1995). *Medical and veterinary entomology*. 2nd edition. CAB International, ISBN: 0-851-98968-3, Cambridge, United Kingdom.

King, W.L.; Bradley, G.H.; Smith, C.N. & McDuffie, W.C. (1960). *A handbook of the mosquitoes of the southeastern United States. Handbook 173*. US Department of Agriculture, Washington, United States of America.

Kirchberg, E. & Mamlok, E. (1946). Malariabekämpfung in Berlin im Jahre 1946. *Ärztl Wochenschr*, Vol.1, pp. 119–122, ISSN 0365-6403.

Kiszewski, A.; Mellinger, A.; Spielman, A.; Malaney, P.; Sachs, S.E. & Sachs, J. (2004). Global Index. Representing the Stability of Malaria Transmission. *American Journal of*

Tropical Medicine and Hygiene, Vol.70, No.5, (May 2004), pp. 486-498, ISSN 0002-9637.

Klobucar, A.; Merdic, E.; Benic, N.; Baklaic, Z. & Krcmar, S. (2006). First record of *Aedes albopictus* in Croatia. *Journal of the American Mosquito Control Association,* Vol.22, No.1, (March 2006), pp. 147-148, ISSN 1046-3607.

Korovitzkyi, L.K. & Artemenko, V.D. (1933). Zur Biologie des *Aedes aegypti. Magasin de parasitologie de l'Institut zoologique de l'Acad´emie des Sciences de l'URSS*, Vol.2, pp. 400-406.

Krüger, A.; Rech, A.; Su, X.Z. & Tannich, E. (2001). Two cases of autochthonous *Plasmodium falciparum* malaria in Germany with evidence for local transmission by indigenous *Anopheles plumbeus. Tropical Medicine & International Health*, Vol.6, No.12, (December 2001), pp. 983-985, ISSN 1360-2276.

Kuhn, K.G.; Campbell-Lendrum, D.H. & Davies, C.R. (2002). A continental risk map for malaria mosquito (Diptera: Culicidae) vectors in Europe. *Journal of Medical Entomology*, Vol.39, No.4, (June 2002), pp. 621-630, ISSN 0022-2585.

Houel, G. & Donadille, F. (1953). Vingt ans de lutte antipaludique au Maroc. *Bulletin de l'Institut d'Hygiène du Maroc*, Vol.13, pp. 3–51.

La Ruche, G.; Souarès, Y.; Armengaud, A.; Peloux-Petiot, F.; Delaunay, P.; Desprès, P.; Lenglet, A.; Jourdain, F.; Leparc-Goffart, I.; Charlet, F.; Ollier, L.; Mantey, K.; Mollet, T.; Fournier, J.P.; Torrents, R.; Leitmeyer, K.; Hilairet, P.; Zeller, H.; Van Bortel, W.; Dejour-Salamanca, D.; Grandadam, M. & Gastellu-Etchegorry, M. (2010). First two autochthonous dengue virus infections in metropolitan France, September 2010. *Euro Surveillance*, Vol.15, No.39, (September 2010), ISSN 1560-7917, Accessed 14th March 2011, Available online in: http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=19676

Leder, K.; Tong, S.; Weld, L.; Kain, K.C.; Wilder-Smith, A.; von Sonnenburg, F.; Black, J.; Grown, G.V. & Torresi, J. (2006). Ilness in travelers visiting friends and relatives: a review of the GeoSentinel Surveillance Network. *Clinical Infectious Diseases*, Vol.43, No.9, (November 2006), pp. 1185-1193, ISSN 1058-4838.

Lewis, D.J. (1943). Mosquitoes in relation to yellow fever in the Nuba Mountains Anglo-Egyptian Sudan. *Annals of Tropical Medicine and Parasitology*, Vol37, No.1, pp. 65-76, ISSN 0003-4983.

Linton, Y.M.; Lee, A.S. & Curtis, C. (2005). Discovery of a third member of the Maculipennis Group in SW England. *European Mosquito Bulletin*, Vol.19, (April 2005), pp. 5-9, ISSN 1460-6127.

Lokki, J.; Saura, A.; Korvenkontio, P. & Ulmanen, I. (1979). Diagnosing adult *Anopheles* mosquitoes. *Aquilo Seriologica Zoologica*, Vol.20, pp. 5-12.

Lozano Morales, A. (1946). Contribución al estudio de la biología del *A. maculipennis var. atroparvus* en función del ambiente. *Revista de Sanidad e Higiene Pública*, Vol.20, pp. 239-250, ISSN 0034-8899.

Luchavez, J.; Espino, F.; Curameng, P.; Espina, R.; Bell, D.; Chiodini, P.; Nolder, D.; Sutherland, C.; Lee, K.S. & Singh, B. (2008). Human Infections with *Plasmodium knowlesi*, the Philippines. *Emerging Infectious Diseases* Vol.14, No.5, (May 2008), pp. 811-813, ISSN 1080-6040.

MacDonald, G. (1957). *The epidemiology and control of malaria*. Oxford University Press, London, United Kingdom.

Madon, M.B.; Mulla, M.S.; Shaw, M.W.; Kluh, S. & Hazelrigg, J.E. (2002). Introduction of *Aedes albopictus* (Skuse) in southern California and potential for its establishment. *Journal of Vector Ecology*, Vol.27, No.1, (June 2002), pp. 149-154, ISSN 1081-1710.

Majori, G.; Maroli, M.; Bettini, S. & Pierdominici, G. (1970). Osservazioni sull'anofelismo residuo nel Grossetano. *Rivista di Parassitologia*, Vol.31, No.2, pp. 147-154, ISSN 0035-6387.

Manouchehri, A.V.; Zaim, M. & Emadi, A.M. (1992). A review of malaria in Iran, 1975–90. *Journal of the American Mosquito Control Association,* Vol.8, No.4, (December 1992), pp. 381-385, ISSN 1046-3607.

Marchant, P.; Rling, W.; Van Gemert, G.J.; Leake, C.J. & Curtis, C.F. (1998). Could British mosquitoes transmit falciparum malaria? *Parasitology Today*, Vol.14, No.9, (September 1998), pp. 344-345, ISSN 0169-4758.

Margarita, Y., Santos Grácio, A.J.; Lencastre, I.; Silva, A.C.; Novo, T.; Sousa, C.; Almeida, A.P.G. & Biscoito, M.J. (2006). Mosquitos de Portugal: primeiro registo de *Aedes (Stegomia) aegypti* Linnaeus, 1762 (Diptera, Culicidae) na Ilha da Madeira. *Acta Parasitológica Portuguesa*, Vol. 13, No.1, pp. 59-61, ISSN 0872-5292.

Mavale, M.S.; Ilkal, M.A. & Dhanda, V. (1992). Experimental studies on the susceptibility of *Aedes vittatus* to dengue viruses. *Acta Virologica*, Vol.36, No.3, (August 1992), pp. 412–416, ISSN 0001-723X.

Monath, T.P. (2006). Yellow fever as an endemic/epidemic disease and priorities for vaccination. *Bulletin de la Societe de Pathologie Exotique*, Vol.99, No.5, (December 2006), pp. 341-347, ISSN 0037-9085.

Moore, C.G. & Mitchell, C.J. (1997). *Aedes albopictus* in the United States: ten-years presence and public health implications. *Emerging Infectious Diseases*, Vol.3,No.3, (July 1997), pp. 329–334, ISSN 1080-6059.

Mori, A.; Oda, T. & Wada, Y. (1981). Studies on the egg diapause and overwintering of *Aedes albopictus* in Nagasaki. *Tropical Medicine*, Vol.23, No.2, (June 1981), pp. 79-90, ISSN 0385-5643.

Mourya, D.T. & Banerjee, K. (1987). Experimental transmission of chikungunya virus by *Aedes vittatus* mosquitoes. *Indian Journal of Medical Research*, Vol.86, (August 1987), pp. 269–271, ISSN 0971-5916.

Nayar, J.K. & Knight, J.W. (1999). *Aedes albopictus* (Diptera: Culicidae): an experimental and natural host of *Dirofilaria immitis* (Filarioidea: Onchocercidae) in Florida, U.S.A. *Journal OF Medical Entomology*, Vol.36, No.4, (July 1999), pp. 441–448, ISSN 0022-2585.

Nikolaeva, N. (1996). Resurgence of malaria in the former Soviet Union (FSU). Society of Vector Ecology News, Vol.27, pp. 10–11.

Nicolescu, G. (1996). George Zotta (1886-1942). An early concept of malaria stratification. *Romanian Archives of Microbiology and Immunology*, Vol.55, No.2, (April 1996), pp. 173-79, ISSN 1222-3891.

Nicolescu, G.; Linton, Y.M.; Vladimirescu, A.; Howard, T.M. & Harbach, R.E. (2004). Mosquitoes of the *An. maculipennis* group (Diptera; Culicidae) in Romania, with the discovery and formal recognition of a new species based on molecular and morphological evidence. *Bulletin of Entomological Research*, Vol.94, No.6, (December 2004), pp. 525-535, ISSN 0007-4853.

Olavarria, J. & Hill, R.B. (1935). Algunos datos sobre las preferencias hemáticas de las *A. maculipennis*. *Medicina de los Países Cálidos*, Vol.8, pp. 169–173.

Papaevangelou, G. & Halstead, S.B. (1977). Infections with two dengue viruses in Greece in the 20th century. Did dengue hemorrhagic fever occur in the 1928 epidemic? *Journal of Tropical Medicine & Hygiene*, Vol.80, No.3, (March 1977), pp. 46-51, ISSN 0022-5304.

Paupy, C.; Delatte, H.; Bagny, L.; Corbel, V. & Fontenille, D. (2009). *Aedes albopictus*, an arbovirus vector: From the darkness to the light. *Microbes and Infection*, Vol.11, No.14-15, (December 2009), pp. 1177-1185, ISSN 1286-4579.

Ponçon, N.; Toty, C.; L'Ambert, G.; Le Goff, G.; Brengues, C.; Schaffner, F. & Fontenille, D. (2007). Biology and dynamics of potential malaria vectors in Southern France. *Malaria Journal*, Vol.6, No.18 (February 2007), ISSN 1475-2875, Accessed 14th March 2011, Available online in: http://www.malariajournal.com/content/6/1/18

Postiglione, M., Tabanli, B. & Ramsdale, C.D. (1973). The Anopheles of Turkey. *Rivista di Parassitologia*, Vol.34, No.2, pp. 127-159. ISSN 0035-6387.

Ramsdale, C.D. & Coluzzi, M. (1975). Studies on the infectivity of tropical African strains of *Plasmodium falciparum* to some southern European vectors of malaria. *Parassitologia*, Vol.17, No.1-3, (January-December 1975), pp. 39-48, ISSN 0048-2951.

Ramsdale, C. & Snow, K. (2000). Distribution of the genus *Anopheles* in Europe. *European Mosquito Bulletin*, Vol.7, (July 2000), pp. 1-26, ISSN 1460-6127.

Ravi, V. (2006). Re-emergence of Chikungunya virus in India. *Indian journal of medical microbiology*, Vol.24, No.2, (April 2006), pp. 83-84, ISSN 0255-0857.

Reiter, P. & Sprenger, D. (1987). The used tire trade: a mechanism for the worldwide dispersal of container breeding mosquitoes. *Journal of the American Mosquito Control Association*, Vol.3, No.3, (September 1987), pp. 494-501, ISSN 1046-3607.

Reiter. P. (2010). Yellow fever and dengue: a threat to Europe? *Euro Surveillance*, Vol.15, No.10, (March 2010), ISSN 1560-7917, Accessed 14th March 2011, Available online in: http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=19509

Rezza, G.; Nicoletti, L.; Angelini, Romi, R.; Finarelli A.C.; Panning, M.; Cordioli, P.; Fortuna, C.; Boros, S.; Magurano, F.; Silvi, G.; Angelini, P.; Dottori, M.; Ciufolini, M.G.; Majori, G.C. & Cassone, A.. (2007). Infection with chikungunya virus in Italy: an outbreak in a temperate region. *The Lancet*, Vol.370, No.9602, (December 2007), pp. 1840-1846, ISSN 0140-6736.

Ribeiro, H.; Batista, J.L.; Ramos, H.C.; Pires, C.A.; Champalimaud, J.L.; Costa, J.M.; Araújo, C.; Mansinho, K. & Pina, M.C. (1989). An attempt to infect *Anopheles atroparvus* from Portugal with African *Plasmodium falciparum*. *Revista Portuguesa de Doenças Infecciosas*, Vol.12, pp. 81-82, ISSN 1646-3633.

Ribeiro, H. & Ramos, H.C. (1999). Identification keys of the mosquitoes of Continental Portugal, Açores and Madeira. *European Mosquito Bulletin*, Vol.3, (January 1999), pp. 1-11, ISSN 1460-6127.

Rioux, J.A. (1958). *Les Culicidés du Midi méditerranéen. Encyclopédie Entomologique XXXV*. Paul Lechevalier, Paris, France.

Romi, R. (1999). *Anopheles labranchiae*, an important malaria vector in Italy, and other potential malaria vectors in Southern Europe. *European Mosquito Bulletin*, Vol.4, (June), pp. 8-10, ISSN 1460-6127.

Romi, R.; Severini, C.; Cocchi, M.; Tamburro, A.; Menichetti, D.; Pierdominici, G. & Majori, G. (1992). Anofelismo residuo in Italia: distribuzione nelle aree risicole delle provincie di Grosseto e Siena. *Annali Dell Istituto Superiore Sanita*, Vol.28, No.4, (December 1992), pp. 527-531, ISSN 0021-2571.

Romi, R.; Pierdominici, G.; Severini, C.; Tamburro, A.; Cocchi, M.; Menichetti, D.; Pili, E. & Marchi, A. (1997). Status of malaria vectors in Italy. *Journal of Medical Entomology*, Vol.34, No.3, (May 1997), pp. 263-271, ISSN 0022-2585.

Romi, R.; Sabatinelli, G.; Giannuzzi Savelli, L.; Raris, M.; Zago, M. & Malatesta, R. (1997). Identification of a North American mosquito species, *Aedes atropalpus* (Diptera: Culicidae), in Italy. *Journal of the American Mosquito Control Association*, Vol.13, No.3, (September 1997), pp. 245-246, ISSN 1046-3607.

Romi, R.; Sabatinelli, G. & Majori, G. (2001). Could malaria reappear in Italy? *Emerging Infectious Diseases*, Vol.7, No.6, (June 2001), pp. 915-919, ISSN 1080-6059.

Rosen, L. (1986). Dengue in Greece in 1927 and 1928 and the pathogenesis of dengue hemorrhagic fever: new data and a different conclusion. *American Journal of Tropical Medicine and Hygiene*, Vol.35, No.3, (May 1986), pp. 642-653, ISSN 0002-9637.

Roubaud, E.; Colas-Belcour, J. & Stefanopoulo, G. (1937). Transmission de fièvre jaune rar un moustique paléarctique répandu dans la region parisiennes, l'*Aedes geniculatus* Olivier. *Compte Rendus Hebdomadaires des Seances de l'Academie des Sciences*, Vol.202, pp. 182-183, ISSN 0567-655X.

Sabatini, A.; Raineri, V.; Trovato, G. & Coluzzi, M. (1990). Aedes albopictus in Italia e possible diffusione del la especie nell' area mediterranea. *Parassitologia*, Vol.32, No.3, (December 1990), pp. 301-304, ISSN 0048-2951.

Sainz-Elipe, S.; Latorre, J.M.; Escosa, R.; Masià, M.; Fuentes, M.V.; Mas-Coma, S.; Bargues, M.T. (2010). Malaria resurgence risk in southern Europe: climate assessment in an historically endemic area of rice fields at the Mediterranean shore of Spain. *Malaria Journal*, Vol.9, No.7, (July 2010), ISSN 1475-2875, Accessed 14th March 2011. Available online in: http://www.malariajournal.com/content/9/1/221

Santa-Olalla Peralta, P.; Vazquez-Torres, M.C.; Latorre-Fandós, E.; Mairal-Claver, P.; Cortina-Solano, P.; Puy-Azón, A.; Adiego Sancho, B.; Leitmeyer, K.; Lucientes-Curdi, J. & Sierra-Moros, M.J. (2010). First autochthonous malaria case due to *Plasmodium vivax* since eradication, Spain, October 2010. *Euro Surveillance*, Vol.15, No.41, (October 2010), ISSN 1560-7917, Accessed 14th March 2011. Available online in: http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=19684

Sardelis, M.R. & Turell, M.J. (2001). *Ochlerotatus j. japonicus* in Frederick County, Maryland: discovery, distribution, and vector competence for West Nile virus. *Journal of the American Mosquito Control Association, Vol.*17, No.2, (June 2011), pp. 137–141, ISSN 1046-3607.

Sardelis, M.R.; Dohm, D.J.; Pagac, B.; Andre, R.G. & Turell, M.J. (2002a). Experimental transmission of eastern equine encephalitis virus by *Ochlerotatus j. japonicus* (Diptera: Culicidae). *Journal of Medical Entomology*, Vol.39, No.3, (May 2002), pp. 480–484, ISSN 0022-2585.

Sardelis, M.R.; Turell, M.J. & Andre, R.G. (2002b). Laboratory transmission of La Crosse virus by *Ochlerotatus j. japonicus* (Diptera: Culicidae). *Journal of Medical Entomology*, Vol.39, No.4, (July 2002), pp. 635–639, ISSN 0022-2585.

Sardelis, M.R., Turell, MJ. & Andre, R.G. (2003). Experimental transmission of St. Louis encephalitis virus by *Ochlerotatus j. japonicus*. *Journal of the American Mosquito Control Association*, Vol.19, No.2, (June 2003), pp. 159–162, ISSN 1046-3607.

Satti, M.H. & Haseeb, M.A. (1966). An outbreak of yellow fever in the Southern Fung and Upper Nile province, Republic of the Sudan. *Journal of Tropical Medicine and Hygiene*, Vol.69, No.1, pp. 36-44, ISSN 0022-5304.

Sautet, J. & Quilici, R. (1971). A propos de quelques cas de paludisme autochtone contractés en France pendant l'été. *Presse Médicale,* Vol.79, pp. 524, ISSN 0755-4982.

Schaffner, F.; Angel, G.; Geoffroy, B.; Hervy, J.O. & Rhaeim, A. (2001). The mosquitoes of Europe / Les moustiques d' Europe [CD-ROM]. IRD Éditions and EID Méditerranée, Montpellier, France.

Schafther, F.; Chouin, S. & Guilloteau, J. (2003). First record of *Ochlerotatus (Finlaya) japonicus japonicas* (Theobald, 1901) in metropolitan France. *Journal of the American Mosquito Control Association*, Vol.19, No.1, (March 2003), pp. 1-5, ISSN 1046-3607.

Schaffner, F., Kaufmann, C. &Mathis, A. (2009). The invasive mosquito *Aedes japonicus* in Central Europe. *Medical and Veterinary Entomology*, Vol.23, No.4, (December 2009), pp. 448-451, ISSN 0269-283X.

Schmidt-Chanasit, J.; Haditsch, M.; Schöneberg, I.; Günther, S.; Stark, K. & Frank, C. (2010). Dengue virus infection in a traveller returning from Croatia to Germany. *Euro Surveillance*, Vol.15, No.40, (October 2010), ISSN 1560-7917, Accessed 14th March 2011. Available online in:
http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=19677

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. Euro Surveillance, Vol.14, No.45, (November 2009), ISSN 1560-7917, Accessed 14th March 2011. Available online in: http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=19400

Scholte, E.J.; Den Hartog, W.; Dik, M.; Schoelitsz, B.; Brooks, M.; Schaffner, F.; Foussadier, R.; Braks, M. & Beeuwkes, J. (2010). Introduction and control of three invasive mosquito species in the Netherlands, July-October 2010. *Euro Surveillance*, Vol.15, No.45, (November 2010) ISSN 1560-7917, Accessed 14th March 2011. Available online in:
http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=19710

Senevet, G.; Andarelli, L. & Adda, R. (1955). Presence of *Anopheles plumbeus* St. in Algerian shores. *Archives de l'Institut Pasteur d'Algérie*, Vol.33, No.2, (June 1955), pp. 138-139, ISSN 0020-2460.

Sepulcri, P. *La malaria nel Veneto*. (1963). Istituto Interprovinciale per la Lotta Antimalarica nelle Venezie, Venice, Italy

Shute, P.G. (1954). Indigenous *P. vivax* malaria in London believed to have been transmitted by *An. plumbeus. Monthly Bulletin of the Ministry of Health and the Public Health Laboratory Service*, Vol.13, pp. 48-51, ISSN: 0368- 881X.

Shute, P. & Maryon, M. (1969). Imported Malaria in the United Kingdom. *British Medical Journal*, Vol.28, (June 1969), pp. 781–785, ISSN 0959-8138.

Shute, P. & Maryon, M. (1974). Malaria in England past, present and future. *Journal of the Royal Society of Health*, Vol.94, (February 1974), No.1, pp. 23-29, ISSN 1466-4240.

Snow, K. & Ramsdale, C. (1999). Distribution chart for European mosquitoes. *European Mosquito Bulletin*, Vol.3, (January 1999), pp. 14-31, ISSN 1460-6127.

Tavşanoğlu, N. & Çağlar, S.S. (2008). The vectorial capacity of *Anopheles sacharovi* in the malaria endemic area of Şanlıurfa, Turkey. *European Mosquito Bulletin*, Vol. 26, (December 2008), pp. 18-23, ISSN 1460-6127.

Teodorescu C. (1983). Experimental infection of an indigenous strain of *Anopheles atroparvus* with imported species of *Plasmodium*. *Archives roumaines de pathologie experimentale et de microbiologie*, Vol.42, No.4, (October 1983), pp. 365-370, ISSN 0004-0037.

Torres Cañamares, F. (1934). Observaciones sobre los *A. maculipennis* y sus razas en Camporredondo (Jaén). *Medicina de los Países Cálidos*, Vol.7, (February 1934), pp. 53-72.

Toty, C.; Barré, H.; Le Goff, G.; Larget-Thiéry, I.; Rahola, N.; Couret, D. & Fontenille, D. (2010). Malaria risk in Corsica, former hot spot of malaria in France. *Malaria Journal*, Vol.9, No.8, (August 2010), ISSN: 1475-2875, Accessed 14th March 2011 Available online in: http://www.malariajournal.com/content/9/1/231

Tovornik, D. (1978). An atypical breeding place of the *Anopheles plumbeus* Stephens, 1828, in an unfinished house. *Biološki vestnik*, Vol.26, pp. 41-46, ISSN 0502-1969

Turell, M.J.; O'Guinn, M.L.; Dohm, D.J. & Jones, J.W. (2001). Vector competence of North American mosquitoes (Diptera: Culicidae) for West Nile virus. *Journal of Medical Entomology*, vol.38, No.2, (March 2001), pp. 130-134, ISSN 0022-2585.

Utrio, P. (1979). Geographic distribution of mosquitoes (Diptera, Culicidae) in eastern Fennoscandia. *Notulae Entomologicae*, Vol.59, pp. 105-123, ISSN 0029-4594.

Wang, K.C. (1966). Observations on the influence of photoperiod on egg diapause in *Aedes albopictus*. Acta Entomologica Sinica, Vol.15, pp. 75-77 ISSN 0970-3721

White, G.B. (1978). Systematic reappraisal of the *Anopheles maculipennis complex*. *Mosquito Systematics*, Vol.7, No.1, (January 1978), pp. 303-344, ISSN 0091-3669.

World Health Organization (WHO). *Malaria*. Fact sheet Nº 94, May 2007, Accessed 14th March 2011 Available online in:
     http://www.who.int/mediacentre/factsheets/fs094/en/print.html/

World Health Organization (WHO), Regional Office for Europe. (n.d.). *Centralized information system for infectious diseases (CISID) database. Malaria.*, Accessed 14th February 2011, Available online in: http://data.euro.who.int/cisid/

Yergolkar, P.N; Tandale, B.V.; Arankalle, V.A.; Sathe, P.S.; Sudeep, A.B.; Gandhe, S.S.; Gokhle, M.D.; Jacob, G.P.; Hundekar, S.L. & Mishra, A.C. (2006). Chikungunya outbreaks caused by African genotype, India, *Emerging Infectious Diseases*, Vol.12, No.10, (October 2006), pp. 1580–1583, ISSN 1080-6040.

Zahar, A.R. (1987). *Vector bionomics in the epidemiology and control of malaria. Part II: The WHO European Region and the WHO Eastern Mediterranean Region*. VBC/88.5. World Health Organization, Geneva, Switzerland. Accessed 14th March 2011 Available online in: http://whqlibdoc.who.int/hq/1990/VBC_90.1_eng.pdf

Zaim, M. (1987). Malaria control in Iran: present and future. *Journal of the American Mosquito Control Association*, Vol.3, No.3, (September 1987), pp. 392-396, ISSN 1046-3607.

Zotta, G. (1938). Contribution à l'etude de la distribution des races d'*A. maculipennis* en Roumanie. *Archives Roumaines de Pathologie Experimentale et de Microbiologie*, Vol.11, pp. 209-246. ISSN 0004-0037.

Zotta, G.; Georgesco, M.; Ionesco, V.; Lupasco, G.; Mardare, I. & Teodoresco, A.M. (1940). Nouvelle carte de la distribution des races d'*Anopheles maculipennis* en Roumanie. *Bulletin de la Section Scientifique de l'Académie Roumaine*, Vol.23, pp. 73-87.

Zulueta de, J.; Blazquez, J. & Maruto, J.F. (1973). Aspectos entomológicos sobre la receptividad del paludismo en la zona de Navalmoral de la Mata. *Revista de Sanidad e Higiene Pública*, Vol.47, No.10, (October 1973), pp. 853-870, ISSN 0034-8899.

Zulueta de J.; Ramsdale, C.D. & Coluzzi M. (1975). Receptivity to malaria in Europe. *Bulletin of the World Health Organization*, Vol. 52, No.1, pp. 109-11, ISSN 0042-9686.
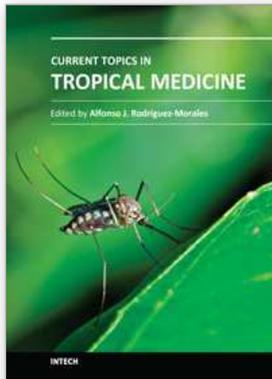
Current Topics in Tropical Medicine

Edited by Dr. Alfonso Rodriguez-Morales

Tropical Medicine has emerged and remained as an important discipline for the study of diseases endemic in the tropic, particularly those of infectious etiology. Emergence and reemergence of many tropical pathologies have recently aroused the interest of many fields of the study of tropical medicine, even including new infectious agents. Then evidence-based information in the field and regular updates are necessary. Current Topics in Tropical Medicine presents an updated information on multiple diseases and conditions of interest in the field. It Includes pathologies caused by bacteria, viruses and parasites, protozoans and helminths, as well as tropical non-infectious conditions. Many of them are considering not only epidemiological aspects, but also diagnostic, therapeutical, preventive, social, genetic, bioinformatic and molecular ones. With participation of authors from various countries, many from proper endemic areas, this book has a wide geographical perspective. Finally, all of these characteristics, make an excellent update on many aspects of tropical medicine in the world.

How to reference

In order to correctly reference this scholarly work, feel free to copy and paste the following:

INTECH
open science | open minds