

chromosomal forms of *Anopheles* that occur in Thailand, only *An. baimaii*, *An. dirus*, *An. minimus*, and *An. maculatus* (each belonging to complexes of species that are often morphologically indistinguishable) are considered major vectors (Pinichpongse and Bullner, 1967; Chareonviriyaphap *et al.*, 1999). The Dirus Complex consists of at least seven closely related species, with five occurring in Thailand (Baimai *et al.*, 1984a,b; Peyton and Ramalingam, 1988; Peyton, 1990; Sallum *et al.*, 2005). Members of this complex inhabit forest and forest-fringe areas, have strong human-biting tendencies, and are generally long-lived, all factors which results in particularly efficient vectors even at low population densities (Rosenberg *et al.*, 1990). In Thailand, the Minimus Complex consists of two species that are commonly found along the quiet, shaded edges of slow moving streams in areas with low hills, with contact with humans usually along the margins of villages (Sucharit *et al.*, 1988; Green *et al.*, 1990). *Anopheles minimus s.l.* are generally reported to be zoophilic, exophilic, and exophagic in their resting and feeding behavior, which reduces their vector efficiency compared to *An. dirus* (Harrison, 1980). The Maculatus Group consists of at least eight sibling species (Rattanaarithikul and Green, 1986; Baimai *et al.*, 1993b; Kittayapong *et al.*, 1993). Members of this group usually occur in hilly forested zones where the larvae occur in shaded puddles in drying streams and other temporary habitats such as rock pools (Rattanaarithikul *et al.*, 1995; Chareonviriyaphap *et al.*, 2000).

### Japanese encephalitis

Japanese encephalitis (JE) is a flavivirus found throughout Southeast Asia. It is endemic in birds and mammals and serological evidence has been reported of widespread human infections in many countries in the region. However, clinical encephalitis has been recognized only sporadically, or in small outbreaks. The primary vectors of JE are various species of the genus *Culex*; however, a number of *Anopheles* species that are found in Thailand have been incriminated as vectors (Table 2). These include *An. subpictus* (Dhanda *et al.*, 1997), *An. sinensis* (Zhang, 1990), *An. annularis*, and *An. vagus* (Olson *et al.*, 1985; Sucharit *et al.*, 1989), *An. peditaeniatus* (Mourga *et al.*, 1989), and various members of the Barbirostris, Hyrcanus, and Umbrosus Groups (Ramachandra Rao, 1984).

### Filariasis

*Wuchereria bancrofti* (Cobbold) and *Brugia malayi* (Buckley) cause Bancroftian and Brugian filariasis, respectively. *Brugia malayi* occurs as periodic and subperiodic forms and is primarily found in the flat coastal plains of southern part of Thailand, whereas *W.*

*bancrofti* primarily occurs in the hilly, forested areas in the western part of Thailand. The main vectors of *B. malayi* are *Mansonia* mosquitoes; however, some species of *Anopheles* (i.e., *An. campestris*) transmit nocturnal periodic types of the parasite (Suvannadabba, 1993). *Wuchereria bancrofti* is largely an urban and suburban disease in many parts of the world due to the habits of its principal vector *Culex quinquefasciatus* (Say); however, in Thailand the disease is primarily rural with transmission by *Anopheles* species and in some cases *Downsiomyia harinasutai* [= *Aedes (Finlaya) harinasutai*] (Knight, 1978). Harinasuta *et al.* (1971) reported that >25% of *An. maculatus*, *An. minimus*, *An. philippinensis*, *An. sinensis* (as *An. hyrcanus sinensis*), *An. stephensi*, *An. subpictus*, and *An. vagus* became infected after feeding on a patient diagnosed with a nocturnal subperiodic strain of *W. bancrofti*. However, many of the species he worked with are now considered species complexes, so precise identification is impossible. A number of other *Anopheles* species have been incriminated as vectors of filariasis (Table 2).

## THE *ANOPHELES* FAUNA OF THAILAND

Harrison (1980) briefly discussed the bionomics of most of the Thai anophelines with respect to forest type. This supported the suggestion of Lekagul and McNeely (1988) that the country could be split up into six biogeographic regions. For ease of interpretation, the spatial distribution of mosquito taxa has been transferred from a biogeographical reference map onto a map that demarcates political, regional, and provincial boundaries (Fig 1). In the introduction (Section I) of this series of papers (Rattanaarithikul *et al.*, 2005) we more completely described each of these subregions. The northern (Subregion 1) and western (Subregion 2) parts of the country are in general hilly, contain high mountains, and dry evergreen forests. The *Anopheles* species in these regions, such as *An. culicifacies* (B), *An. varuna*, and *An. pseudowillmori*, are usually considered to be of Indian origin. The ranges of several of the anophelines found in these regions, such as *An. minimus s.l.* and *An. nivipes*, extend to the most southern Thai provinces and probably into southern Myanmar. The south (Subregion 3) and the primary forests of Chanthaburi and Trat (Subregion 4) contain evergreen rain forests, particularly along the Thai-Malaysia border. The ranges of a number of typically Malayan *Anopheles*, such as *An. donaldi*, *An. paraliae*, and some members of the Umbrosus Group therefore extend into Thailand. The Korat Plateau (Subregion 6) and the central valley (Subregion 5) have similar anopheline faunas. In general (except for the southern slope of the mountains found on the southern edge of the plateau), the Korat Plateau is drier than the other regions of the country. The southern slopes of the mountains in this subregion have