

Mosquito Survey and Taxonomic Studies

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OBJECTIVE : To elucidate the mosquito fauna of Thailand and Southeast Asia, with primary emphasis on the identification of diagnostic characters for the separation of vector species and groups containing vector species of human pathogens.

BACKGROUND : This is a continuation of efforts begun in the early 1960's and currently conducted in partial collaboration with the Medical Entomology Project (MEP), Smithsonian Institution, Washington, D.C. A brief review of the history of these efforts was presented in the previous annual report (1).

METHODS : Surveys for target species and species groups are conducted at selected sites and habitats throughout Thailand. These surveys involve the collection of immature and adult mosquitoes, with emphasis placed on reared adults with associated larval and pupal skins, and on progeny adults (with associated larval and pupal skins) reared from eggs oviposited by known wild collected females. Specimens are curated and pinned or slide mounted for further study by investigators in the laboratory, or shipped for study to MEP or other world recognized authorities. Studies primarily consist of an analysis of intra-interspecific variations to identify useful characters for separating the species. Useful diagnostic characters, new species records, and new taxa found in Thailand are prepared for publication and described in scientific journals.

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RESULTS : During this period major research efforts went into support for the monographic revisionary study of the Leucosphyrus Group of *Anopheles* (*Cellia*) by personnel at the Medical Entomology Project (MEP), Smithsonian Institution, Washington, D.C. These collaborative efforts are responsible for the recent discovery that the primary malaria vector species in Thailand, previously called *balabacensis*, is morphologically distinct in the adult, pupal and 4th larval stage from topotypic *balabacensis* from Balabac Island, Philippines, and specimens of this species from the adjacent areas of Palawan Island, Philippines and Sabah, East Malaysia. Accordingly, the Thai species has been redescribed as a new species, *Anopheles dirus* (2). Historically, a number of major malaria-vector efforts in Thailand (e.g. 3, 4) have been based on *dirus* (as *balabacensis*). In addition, *dirus* has been colonized since 1964 and is known around the world as the Khao Mai Khaeo or Bangkok Strain (of *balabacensis*), and has been used for years in numerous experimental malaria research projects and scientific publications. Current ongoing research with this species consists of: (A) cross mating experiments with strains of *balabacensis* sensu lato, from Southeast Asia; (B) continuing taxonomic studies; and (C) cytogenetic and electrophoresis studies (5, and this Annual Progress Report).

Field and laboratory support for the Leucosphyrus Group studies resulted in the shipment of 1,898 adults and 1,786 slides of whole larvae and larval and/or pupal skins of the above adults to the Medical Entomology Project, Smithsonian Institution. Approximately half of these specimens were progeny broods from laboratory colonies, while the remainder consisted of reared feral adults (with associated immature skins) and progeny broods from feral females from several areas of Thailand. These specimens are being analyzed for intra-interspecific variations, with emphasis on the discovery and confirmation of reliable key characters for differentiating the taxa in this group. Biological and behavioral data from the laboratory and field collections are being analyzed for additional information of potential use in differentiating the various taxa being studied.

Several very capable vectors of human malarial parasites in the Indian sub-region, that are uncommon or rare in Thailand, were collected during this period. *Anopheles stephensi* and *varuna* were collected as larvae (and reared) from stream pools in Hang Dong District, Chiang Mai Province. *Anopheles culicifacies* larvae were found common in the Mae Klong river (Khwaie Yai) just 12 km upstream from Kanchanaburi. The first 2 species are very uncommon and known only from the northwest corner of Thailand. However, *culicifacies* is more widespread and is possibly becoming more abundant. Since *culicifacies* has developed DDT resistance in northern Thailand (6), its distribution and abundance deserve close watch.

A monographic study of the *Anopheles* Myzomyia Series in Thailand, including *aconitus*, *culicifacies*, *jeyporiensis*, *minimus*, *pampanai* and *varuna*, has been completed and submitted for publication (7). Both *aconitus* and *minimus* are confirmed vectors of human malarial parasites in Thailand. This study summarizes nearly 3 years of field work in Thailand and over 3 years of laboratory-museum work on more than 36,000 specimens.

Anopheles compestris, an established vector of human malarial parasites in Malaysia and a potential vector in Thailand, has been recorded from the Chiang Mai Valley in northern Thailand on several occasions. A series of 247 adults

of the Barbirostris Group, reared with 4th stage larval and/or pupal skins from collections in 5 districts in and adjacent to the valley, was recently examined for *campestris*. Although most adults were identifiable as *barbirostris*, some possessed key characters identifying them as *campestris*, while others were intermediate. Fortunately, the pupal stage contains the best diagnostic characters for separating these 2 species in Thailand (8), and the pupae were clearly all *barbirostris*. All of the 4th stage larval skins that were examined were also *barbirostris*. Accordingly, previous records of *campestris* in Chiang Mai should be disregarded, and probably were based on adult variants of *barbirostris*.

In certain sections of eastern Indonesia, human malarial and filarial parasites (*Brugia malayi* and *B. timori*) are transmitted by *Anopheles barbirostris*, which in the remainder of its wide distribution is a poor or non-vector. These vectorial and certain morphological differences have been used in the past to justify the description of a subspecies, *innominata*, for the vector strain of *barbirostris* (9). The possibility of another sibling species in the Barbirostris Group recently prompted a morphological re-examination of specimens from eastern Indonesia, Malaysia, Thailand and other areas. This collaborative effort concluded that specimens of the vector strain from the islands of Sulawesi, Flores and Timor were conspecific with *barbirostris* from Java, Malaysia, Thailand and elsewhere (10). Adults of the vector strain were found more variable, however the immature stages were all clearly *barbirostris*. The variations noted were considered intraspecific and it was concluded that the recognition of the subspecific name, *innominata*, is not warranted.

Anopheles maculatus is currently recognized by the Malaria Division, Thai Ministry of Public Health, as a primary vector of human malarial parasites in Thailand. However, *maculatus* is apparently a vector only (or primarily) in southern Thailand near the Malaysian border. A critical morphological re-examination of this species is urgently needed in Thailand and adjacent areas of adults of *maculatus* have been reared with associated immature skins from Chiang Mai, Chumphon and Phangnga provinces and collections are continuing. A previously unreported melanistic mutant of *maculatus* has also been described with notes on the inheritance of this trait (11).

The revisionary study on the *Aedes (Finlaya) kochi* group of species in Thailand and Malaysia (1) made significant progress during this period. Over 1,800 specimens (adults and immature slides) of the Poicilius Subgroup and approximately 150 adults and immatures of the Flavipennis Subgroup were collected in Thailand and curated for future study. Currently, 4 species in the Kochi Group are recognized from this study area. Reliable diagnostic characters have been found for the adults and immatures of these species. Descriptions and illustrations are being prepared for publication.

In the previous Annual Progress Report (1), a large series of specimens from Kanchanaburi Province was noted as shipped to the Medical Entomology Project, Smithsonian Institution. These specimens were recently described as a new *Aedes* subgenus, *Isoaedes*, and a new species, *cavaticus* (12). This new taxon is apparently a true cave dwelling species known only from Gang Lawa Cave, Huai Bong Ti, in Kanchanaburi Province.

Two training courses were offered during the year. The first, "Curatorial Techniques for Mosquito Specimens", was conducted during the period 19-27 March 1979, and 4 participants from the Thai Ministry of Public Health attended. The second course, "Entomological Field and Laboratory Techniques for Malaria Surveillance", was offered during the period 2 July to 17 August 1979, and was attended by 2 Royal Thai Navy Personnel.

These studies are continuing.

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