Vector part in Thailand

Research areas

Objectives

A. Determine how environmental changes and the mosquito community structures and transmission of different parasite species.

B. Determine the genetic basis of different biting behaviors of *An. minimus* (outdoor/indoor biters, early/late biters, human/animal biters) using pooled genome-wide association study.

C. Determine spatial population genetic structures of malaria vectors, *An. minimus*.

D. Determine the extent, distribution and mechanisms of insecticide resistance in a major malaria vector mosquito by bioassays and RNA-seq and targeted deep sequencing of candidate genes.

Key achievements

1. **Vector biology, distribution, and seasonal dynamics**
   Define and monitor the malaria vector distribution, taxonomic, and species complex varieties are the highlight gap knowledge for malaria vector in SEA. The complexity from natural vector community have been defined. This finding has extended with further surveys of natural Anopheles community structures, malaria susceptibility, and their seasonal dynamics. An in-depth knowledge of locally specific malaria vectors in term of vector capacity, were performed (1, 8).

2. **Vector transmission complexity**
   Transmission dynamics were investigated and analysed. Many scenarios of the cross border malaria transmission in the village scale (2), the patterns of multiple risks of malaria transmission both in human movement (3) and the residual malaria transmission particularly the outdoor transmission patterns (4) were performed. Therefore, asymptomatic transmission to the main vector, *An. dirus* opened the key factor of transmission dynamic in the malaria hot spot (5). Continue the vector surveillance to monitor the malaria tranmssion situation is the important tool. We have set our vector surveillance system and implement the tool to the routine work with the evaluation (6).

3. **The vector species complexity is the important key of malaria transmission in SEA.** Defining and update the local species complex of the primary vectors have been reported (7, 8). We have developed the Geometric Morphometric tools as the alternative field mosquito identification (7, 9).

4. **Our currently researches** are 1) the genetic population of the main vector, *An. minimus*, 2) the natural vector survivorship impacted by environmental patterns that are very important for estimating the transmission cycle. 3) The genetic basis of different biting behaviors of *An. minimus* and 4) Determination of the extent, distribution and mechanisms of insecticide resistance (10) are paralleled studied.

5. **Entomological study is a part of MPPT activities**. The entomological study has been performed in MPPT study sites among 4 selective village groups in Southern part of Thailand, Yala and Narathiwad provinces, where the treatment and control groups are parallel accessed for 2 years. The objectives are to determine the malaria vector transmission status during mass drug treatment in the control and treatment villages.

Regional Impact

Our research has helped to fill gaps in malaria vector knowledge and help inform suitable vector control programs, feeding into the plan for the effective pre-elimination phase in the region. Provide the vector surveillance tools and identification are implemented to monitor the transmission status in the hot spot

areas. Yong Entomologist has approached to the local for self-malaria vector surveillance system that fulfill and merge the local responsibility for malaria elimination.

Publications

1. Sriwichai P, Samung Y, Sumruayphol S, Kiattibutr K, Kumpitak C, Payakkapol A, Kaewkungwal J, Yan G, Cui L, Sattabongkot J. Natural human Plasmodium infections in major Anopheles mosquitoes in western Thailand. Parasit Vectors. 2016 Jan 13;9:17. doi: 10.1186/s13071-016-1295-x. PubMed PMID: 26762512; PubMed Central PMCID: PMC4712558.
2. Sriwichai P, Karl S, Samung Y, Kiattibutr K, Sirichaisinthop J, Mueller I, Cui L, Sattabongkot J. Imported Plasmodium falciparum and locally transmitted *Plasmodium vivax*: cross-border malaria transmission scenario in northwestern Thailand. Malar J. 2017 Jun 21;16(1):258. doi: 10.1186/s12936-017-1900-2. PubMed PMID: 28637467; PubMed Central PMCID: PMC5480133.
3. Saita S, Pan-Ngum W, Phuanukoonnon S, Sriwichai P, Silawan T, White LJ, Parker DM. Human population movement and behavioural patterns in malaria hotspots on the Thai-Myanmar border: implications for malaria elimination. Malar J. 2019 Mar 8;18(1):64. doi: 10.1186/s12936-019-2704-3.
4. Edwards HM, Sriwichai P, Kirabittir K, Prachumsri J, Chavez IF, Hii J. Transmission risk beyond the village: entomological and human factors contributing to residual malaria transmission in an area approaching malaria elimination on the Thailand-Myanmar border [published correction appears in Malar J. 2019 Jul 24;18(1):248]. *Malar J*. 2019;18(1):221. Published 2019 Jul 1. doi:10.1186/s12936-019-2852-5
5. Kiattibutr K, Roobsoong W, Sriwichai P, Saeseu T, Rachaphaew N, Suansomjit C, Buates S, Obadia T, Mueller I, Cui L, Nguitragool W, Sattabongkot J. Infectivity of symptomatic and asymptomatic Plasmodium vivax infections to a Southeast Asian vector, *Anopheles dirus*. Int J Parasitol. 2017 Feb;47(2-3):163-170. doi: 10.1016/j.ijpara.2016.10.006. Epub 2016 Dec 30. PubMed PMID: 28043858; PubMed Central PMCID: PMC5725394.
6. Sriwichai P, Karl S, Samung Y, Sumruayphol S, Kiattibutr K, Payakkapol A, Mueller I, Yan G, Cui L, Sattabongkot J. Evaluation of CDC light traps for mosquito surveillance in a malaria endemic area on the Thai-Myanmar border. Parasit Vectors. 2015 Dec 15;8:636. doi: 10.1186/s13071-015-1225-3. PubMed PMID: 26666683; PubMed Central PMCID: PMC4678759.
7. Chatpiyaphat K, Sumruayphol S, Dujardin JP, Samung Y, P ayakkapol A, Cui L, Ruangsittichai J, Sungvornyothin S, Sattabongkot J, Sriwichai P. Geometric morphometrics to distinguish the cryptic species *Anopheles minimus* and *An. harrisoni* in western Thailand. Med Vet Entomology 2020 (Revision).
8. Sumruayphol S, Chaiphongpachara T, Samung Y, Ruangsittichai J, Cui L, Zong D, Sattabongkot J, Sriwichai P. Geometric morphometrics to distinguish the cryptic species *Anopheles minimus* and *An. harrisoni* Seasonal dynamic and molecular differentiation among three natural Anopheles (Cellia) species (Diptera: Culicidae) of the Maculatus group (Neocellia series) distribution in malaria hot spot village of Thailand. Parasite & Vectors 2020. (Submitted).
9. Chaiphongpachara T, Sriwichai P, Samung Y, Ruangsittichai J, Morales Vargas RE, Cui L, Sattabongkot J, Dujardin JP, Sumruayphol S. Geometric morphometrics approach towards discrimination of three member species of Maculatus group in Thailand. Acta Trop. 2019 Apr;192:66-74. doi: 10.1016/j.actatropica.2019.01.024.
10. Sriwichai P, Samung Y, Datong P, Srisawad R, Cui L, Sattabongkot J, Yan G, Zhong D. Fast Emerging Deltamethrin Resistance of the Major Vectors in Hot Spots of Malaria Transmission in Thai-Myanmar Border Region. PLOS NDTs 2020. (Manuscript).