

RESEARCH NOTE

PRELIMINARY STUDIES OF *ANOPHELES* MOSQUITOS IN EIGHT PROVINCES IN LAO PDR

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Abstract. Malaria vector surveys were carried out in 8 provinces in Lao PDR in 1999. The surveys were conducted in 4 provinces - Savannakhet, Champasak, Luang Prabang and Sayaboury in May and in another 4 provinces - Bolikhamsay, Sarvan, Sekong and Vientiane in December 1999. Bare leg collection were carried out indoors and outdoors from 6 pm to 5 am. All anopheline mosquitos were identified, dissected and the gut, gland and ovaries were examined. A total of 438 *Anopheles* mosquitos belonging to 19 species were obtained. Of these only 3 species were found to be infected with oocysts - *An. maculatus*, *An. dirus* and *An. minimus*. All these species were found biting both indoors and outdoors. *An. aconitus* was the predominant species obtained in the December collection but its vectorial status remains unknown.

Malaria continues to be one of the most serious public health problems facing Lao PDR. The exact prevalence of malaria in Lao PDR, however, is not known because the recorded cases were passively detected patients admitted to hospitals (Kobayashi *et al*, 1998). The anopheline situation in Lao PDR is complex both taxonomically and ecologically. The main vectors of malaria in the country are not very clear. This preliminary study was carried out to determine the mosquito vector species and to map the anopheline distribution for the country.

The study was carried out in 4 Provinces (Savannakhet, Champasak, Luang Prabang and Sayaboury) in May 1999 and another 4 Provinces (Borikhamsay, Saravan, Sekong and Vientiane) in December 1999. Study of the malaria vectors in some of the villages have been carried out for the first time.

Savannakhet is 600 km south of Vientiane. Mosquito collections were carried out in Saloy village, located in Phine district about 160 km east of Savannakhet. It is a semi-mountainous area close to the forest edge and bordering Vietnam.

Champasak lies southwest of the country and the capital Pakse is located at the confluence of the Mekong and Sedone rivers. Studies were carried out in Houaynamphak village in Pathoumphon district which is located 25 km from the town of Pakse.

Luang Prabang is to the North of Vientiane. It is situated at the confluence of the Khan and Mekong rivers. It is surrounded by green hills. Mosquito collections were carried out in Pak Ou district, 57 km from Luang Prabang.

Sayaboury is situated in the northwest of Lao PDR, sharing borders with Vientiane and Luang Prabang in the east and Thailand in the west. The study was carried out in Nakeo village in Phieng district which is 40 km away from Sayaboury. The area is mainly agricultural, surrounded by paddy fields.

Borikhamsay is located in central Lao PDR in the narrow neck with moderately high mountains sloping southwest into the Mekong district river valley. Mosquito collection was carried out in Khammoun, Vanko and Ban Don villages in Khamkheuth district which lies in

the south of the province. The most striking attraction in this area is the stone forest featuring thousands of rock pinnacles.

Saravan is a southeastern province, situated on the Bolvaen Plateau. It is mainly an agricultural province with vast stretches of rice fields. On the eastern side it borders Vietnam. Mosquito collections were carried out in Navieng, Don Ko and Thaheol villages in Saravan district.

Sekong Province is situated in the south-eastern part of Lao PDR and has common borders with Saravan to the west, Champassak and Attapeau to the south and Vietnam to the east. The Sekong river valley is characterized by a landscape of a fertile plain patterned with a patchwork of paddy fields and fruit orchards. Mosquito collections were carried out in Mo, Nava and Pakthom villages in Lamam district.

Mosquito collections were also carried out in Na Ang village, Fuang district in Vientiane Province. It is situated on flat land at the foothills of the forested mountains.

The residents of the villages were either of ethnic Lao Theung or Lao Loum origin. The wet season is from May to October and the dry season occurs from November to April. All villages in this study were accessible by road. Village population ranged from 95 to 982. The houses are made of either wood or bamboo with thatched roofs and are built on stilts. Most of the houses are very similar, except that some have more gaps in the walls. The common animals in the villages include cattle, buffalos, pigs and dogs. Some villages have more animals than others.

All night human landing collections were carried out in these villages in two houses for a period of 2 or 3 days. Paired indoor and outdoor landing catches were carried out by 16 collectors working in 2 teams of 8, one team working from 18.00 to 24.00 hours and the other from 24.00 to 05.00 hours. All mosquitos were taken to the field laboratory and the anophelines were identified morphologically. Most of the *Anopheles* species were dissected and the gut and gland were examined for

infection.

In the month of May, the Culicine population comprised more than 80% of the total mosquito fauna in the 4 provinces surveyed; while in the month of December they comprised less than 50% (with the exception of Saravan Province-58.8%).

A total of 438 *Anopheles* mosquitos belonging to 19 species were obtained as shown in Table 1. Three species of mosquitos positive for oocysts were *Anopheles dirus* (5), *An. maculatus* (2) and *An. minimus* (2). *An. dirus* was found in all provinces with the exception of Borikhamsay, Saravan and Vientiane Province. *An. maculatus* was found in all provinces except Vientiane. *An. minimus* was found in all provinces with the exception of Sayaboury, Champassak and Sekong. None of the mosquitos dissected were infected with sporozoites. It is probable that *An. dirus*, *An. minimus* and *An. maculatus* play an important role in the transmission of malaria. These three species were found biting both indoors and outdoors. *An. maculatus* and *An. dirus* were found biting in the early part of the night while *An. minimus* was biting in the later part of the night after 22.00 hours.

An. aconitus was found in all provinces with the exception of Savannakhet. It was a predominant species in the provinces surveyed during the dry season in December 1999. *An. aconitus* which is closely related to *An. minimus*, is one of the most widely distributed *Anopheles* in Asia (Harrison, 1980) and it has been incriminated in Thailand (Gould *et al*, 1967), India (Rao, 1984), Indonesia, particularly Java (Soerono *et al*, 1965; Sundaraman *et al*, 1957) and Bangladesh (Maheswary *et al*, 1992). This species is adapted to climates with dry season (Reid, 1968). It breeds in a wide variety of habitats, but seems to prefer emergent vegetation and a slow current, so it is often found in and around lowland cultivation, such as paddy fields. Generally it is exophilic, exophagic and prefers to feed on bovines to man at ratios of 5:1 or higher (Harrison, 1980). In this study it was found biting both indoors as well as outdoors throughout the night.

Table 1
Distribution of *Anopheles* mosquitos in Lao PDR.

Species	Savannakhet	Champassak	L Prabang	Sayaboury	Borikhamsay	Saravan	Sekong	Vientiane P	Total
<i>An. hyrcanus</i> gr	-	-	10	13	64	4	-	1	92
<i>An. barbirostris</i>	1	-	1	1	1	7	5	1	17
<i>An. albotenaius</i>	-	-	-	1	-	-	-	-	1
<i>An. tessellatus</i>	-	-	-	3	1	-	-	-	4
<i>An. kochi</i>	-	-	1	4	7	10	1	-	23
<i>An. dirus</i>	20	13	5	1	-	-	3	-	42
<i>An. aconitius</i>	-	1	1	5	22	11	13	13	66
<i>An. minimus</i>	1	-	22	-	4	1	-	11	39
<i>An. pampani</i>	-	-	-	-	-	1	6	-	7
<i>An. varuna</i>	-	-	3	-	-	-	-	1	4
<i>An. subpictus</i>	-	-	-	-	-	-	2	-	10
<i>An. vagus</i>	-	-	-	3	4	2	-	-	9
<i>An. maculatus</i>	3	4	14	3	1	9	10	-	44
<i>An. kawari</i>	-	-	-	1	1	3	-	-	5
<i>An. jamesi</i>	-	-	-	3	1	-	-	-	4
<i>An. splendidus</i>	-	-	3	-	4	3	-	-	10
<i>An. nivipes</i>	-	8	8	10	13	4	5	-	48
<i>An. philippinensis</i>	-	2	-	-	8	-	2	-	12
<i>An. pallidus</i>	-	-	-	-	1	-	-	-	1
Total	25	28	68	48	140	55	47	27	438

Besides the above mentioned species, *An. nivipes* was also found in considerably large numbers. This species is found in Assam eastwards through Burma, Thailand, Malaya and Indo China (Reid, 1968). Larvae are usually found in fairly clean, still or slow moving water with vegetation such as grassy edges of rice fields and in ponds, swamps and irrigation channels. This species is more attracted to cattle (Kobayashi *et al*, 1997), however, it has also been found biting man indoors. It bites more outdoors than indoors and bites throughout the night. *An. nivipes* has also been found to be a predominant species in a study carried out in Khammoune Province Lao PDR in 1996 (Kobayashi *et al*, 1997). In a study carried out in Tak Province in Northwest Thailand, a single specimen of *An. nivipes* was strongly positive for *P. vivax* by ELISA (Harbach *et al*, 1987).

Besides *An. nivipes*, its sister species, *An. philippinensis* was also found but in much smaller numbers. *An. philippinensis* has also been found infected with human malaria parasite in India (Covell, 1944, Ganguli, 1947) in Bangladesh (Quraishi *et al*, 1951) and in Burma (Feegrade, 1926). Both these species occur together from India to Vietnam (Reid 1968). These two species are morphologically very similar. The specimens were identified as *An. nivipes* by the presence of a long presector dark spot on wing vein R (Reid, 1968).

An. subpictus was found in Borikhamsay and in Sekong Provinces. This species was found biting both indoors and outdoors and in the early part of the night and after midnight. It has been reported from Middle East to India, parts of Malaya, Java, Celebes and New Guinea and also from Indo China and South China. Although infected specimens have been found in India it is not considered to be a vector of importance. However it appears to be a vector of some importance in Celebes (van Hell, 1952) and records of infection has been reported from Java (Covell, 1944). It is also considered a secondary vector in the coastal plain north of the Mekong delta area in Vietnam (Vu *et al*, 1999).

The parous rate of the *Anopheles* mosquitos was highest in Savannakhet being 86.4%. In Vientiane Province, Sayaboury and Saravan it was above 60%. Only in Sekong Province the parous rate was 44.7%. In all these villages vector control measures are lacking. From this brief random survey it is obvious that further work is warranted in order to determine the primary and secondary vectors and their behavior. A number of species found here, have been incriminated as vectors in some countries, thus it is important to elucidate the status of these species of mosquitos. This can only be answered after in depth investigations have been carried out.

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