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Species composition of mosquito fauna in Ranau, Sabah, Malaysia

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Abstract. The adult population and species composition of mosquitoes collected in Ranau, Sabah are described. A total of 5956 mosquitoes representing 8 genera and 41 species were collected using human landing catch, indoor and outdoor. *Anopheles maculatus* was the most common species (15.6%) followed by *Culex quinquefasciatus* (12.8%), *Culex pseudovishnui* (12.1%), *Anopheles balabacensis* (11.1%), *Culex vishnui* (9.7%), *Aedes vexans* (9.6%), *Culex tritaeniorhyncus* (6.6%), *Anopheles donaldi* (5.6%) and others in very small percentage.

INTRODUCTION

Human malaria remains as the single most important arthropod-borne disease of man worldwide. While effective chemo-prophylactic agents and drug treatment regimes are available to prevent and treat malaria infections, widespread resistance of vectors to insecticides are major factors contributing to resurgence of malaria in many regions in the world (WHO, 2006). Malaysia has achieved major success in virtually eliminating malaria from urban and other densely populated areas. Malaria cases in the country are declining significantly from highly endemic state of more than 200,000 cases a year in 1960's (243,870 in 1961) to a record low of 5,569 cases in 2005. Sixty percent of all cases occurred in Sabah (VBDCP, 2005). In Sabah, about 80% of the country is hilly and forested. These hills are traversed by valleys and occasional plains. Mountainous terrains are ideal for the breeding of the forest mosquito *Anopheles balabacensis*. This is one of the reasons why malaria continues to pose a health threat in hilly forested areas and remote communities (VBDCP, 2005).

Studies carried out by the Entomology component of the collaborative programme of the Institute for Medical Research and Sabah Vector Borne Disease Department on malaria vectors research in Ranau, Sabah established that the vector of malaria is *An. balabacensis* and documented their biting activity cycles. These results and a record of the *Anopheles* mosquito fauna using different collection methods were documented (Rohani *et al.*, 1999). In the course of the above studies, other mosquito species collected from Ranau were also recorded. These observations are reported in this paper.

MATERIALS AND METHODS

The study was carried out in Ranau District, Sabah (05°58'N, 116°42E), where the incidence of malaria was the highest in Sabah. Villages were selected based on available epidemiological records. Field evaluations were conducted in six villages: Pinanwantai, Pahu, Togop Laut, Tarawas, Tibabar, Tumbalang and Menkodou. The villages were chosen based on: high malaria

incidence rate, high vector populations and village accessibility at all times of the year. Mosquitoes were collected using human landing catches. Author names for the species are provided in Table 1.

Twelve hour overnight mosquito collections were carried out bi-monthly, from 7:00 pm to 7:00 am with two collectors simultaneously stationed indoors and two outdoors. All mosquitoes landing on human baits were caught using 50X19 mm glass vials, which were subsequently plugged with cotton. Two houses were selected for each village during 2 collection nights for each survey. Captured female mosquitoes were identified by an expert taxonomist the following morning and were segregated according to species, village and date. Identification was based on adult characters using established taxonomic keys (Delfinado, 1966; Reid, 1968; Sallum *et al.*, 2005).

RESULTS AND DISCUSSION

The identification of the species and distribution records are not simply of academic interest, but are vital for effective malaria control. Species identification provides the associated knowledge of the biology of that species which in turn, dictates appropriate control measures. Furthermore, the association between species of mosquitoes can provide clues to understanding their biology and their role in the transmission of pathogens. Detailed information on the biology and ecology of the mosquito fauna of the region is also necessary for development of ecologically sensitive and efficient mosquito control strategies. Results were based on cumulative collections from all the study villages. Adult mosquito collections were made on 43 nights in Ranau and a total of 2,110 anophelines and 3,846 culicines were caught during the survey. The species of mosquitoes collected by month is given in Table 1.

The survey found the presence of the following anopheline species: *An. balabacensis*, *Anopheles maculatus*, *Anopheles donaldi*, *Anopheles philippinensis*, *Anopheles tessellatus*, *Anopheles leucosphyrus* group, *Anopheles barbirostris* and the following culicine species: *Culex quinquefasciatus*, *Culex pseudovishnui*, *Culex vishnui*, *Culex nigropunctatus* and *Culex bitaeniorhyncus*. The other species found were: *Aedes albopictus*, *Aedes poicilius*, *Mansonia dives* and *Mansonia uniformis*.

A total of 5,956 mosquitoes representing 8 genera and 41 species were collected using human landing catches, indoor and outdoor. *Anopheles maculatus* was the most abundant species (15.6%) followed by *Cx. quinquefasciatus* (12.8%), *Cx. pseudovishnui* (12.1%), *An. balabacensis* (11.1%), *Cx. vishnui* (9.7%), *Ae. vexans* (9.6%), *Cx. tritaeniorhyncus* (6.6%), *An. donaldi* (5.6%), and others in smaller percentages.

Anopheles formed 35.43% of the total collections from five entomological suveys conducted during the study period. The most abundant anopheline mosquitoes were *An. maculatus*, *An. balabacensis* and *An. donaldi*, respectively. *Anopheles maculatus* was the most dominant anopheline species collected in the study areas. The greatest number of *An. maculatus* occurred during September (n=526). The lowest number of this species was found in March (n=65). *Anopheles maculatus* has been incriminated as the vector of malaria in peninsular Malaysia (Reid, 1968) and was collected in all the study villages, but has not been incriminated as a malaria vector in Sabah and Sarawak. *Anopheles balabacensis* was the second most common species. The largest number of *An. balabacensis* collected was in June (n=255). *Anopheles balabacensis* was collected from all the villages in the study area. *Anopheles balabacensis* has been incriminated as the malaria vector in the study area (Reid, 1968) and also in parts of the Philippines, Brunei and Indonesia (Sallum *et al.*, 2005). *Anopheles balabacensis* prefers biting humans over cattle, is exophilic, and bites outdoors at the same times as found in the indoor biting catches (Rohani *et al.*, 1999).

Table 1: Record of mosquitoes trapped in Ranau, Sabah

Mosquito species	March	June	Sept	Nov	Total
Ae. albopictus (Skuse)	14	33	24	4	75
Ae. albosculellatus (Theobald)	–	2	–	1	3
Ae. flavipennis (Giles)	–	1	–	–	–
Ae. lineatopennis (Ludlow)	–	1	–	–	1
Ae. poicilius (Theobald)	66	14	3	–	83
Ae. vexans (Meigen)	22	38	206	309	575
An. argyropus (Swellengrebel)	–	–	9	–	9
An. balabacensis Baisas	151	255	126	130	662
An. barbirostris van der Wulp	–	2	–	3	5
An. donaldi Reid	53	78	107	93	331
An. introlatus Colless	1	–	–	–	1
An. karwari (James)	–	–	1	–	1
An. kochi Doenitz	2	1	23	4	30
An. maculatus Theobald	65	194	526	147	932
An. peditaeniatus (Leicester)	–	2	2	3	7
An. philippinensis Ludlow	1	–	1	2	4
An. tessellatus Theobald	7	17	27	17	68
An. umbrosus (Theobald)	–	3	–	–	3
An. vagus Doenitz	–	13	4	7	24
An. vanus Walker	6	2	13	12	33
Ar. balteatus Macdonald	-	3	–	–	3
Ar. flavus (Leicester)	1	3	–	3	7
Ar. jugraensis (Leicester)	1	–	–	–	1
Ar. malayi (Theobald)	6	–	–	4	10
Ar. pendulus Edwards	–	5	–	–	5
Cq. crassipes van der Wulp	–	1	3	–	4
Cx. bitaeniorhynchus Giles	51	7	66	7	131
Cx. fragilis Ludlow	–	–	–	2	2
Cx. fuscocephala Theobald	8	11	1	8	28
Cx. gelidus Theobald	67	38	30	124	259
Cx. nigropunctatus Edwards	1	1	1	7	10
Cx. pseudovishnui Colless	49	13	657	2	721
Cx. quinquefasciatus Say	363	145	142	114	764
Cx. tritaeniorhynchus Giles	92	166	77	60	395
Cx. vishnui Theobald	35	127	47	371	580
Lutzia sp.	–	–	1	–	1
Ma. annulifera (Theobald)	1	1	–	–	2
Ma. dives (Schiner)	21	1	6	3	31
Ma. Indiana Edwards	–	6	–	–	6
Ma. uniformis (Theobald)	44	59	28	16	147
Uranotaenia sp.	1	–	–	–	1
Total	1129	1243	2131	1453	5956

Anopheles donaldi was found predominantly in the month of September (n=107) and was collected in the villages of Merungin, Pahu, Menkodou, Togop Laut and Pinanwantai. It has been incriminated as the vector of malaria in Kinabatangan, Sabah (Vythilingam *et al*., 2005) and is the vector of periodic *Brugia malayi* in Grik, Perak in Peninsular Malaysia (Vythilingam *et al*., 1996). It breeds in shady forest pools near the edge of forest, mainly in hilly areas not far from swamp forest (Sandosham & Thomas, 1982).

Culex species comprised 64.57% of the total mosquito fauna for the study period. Of these *Cx. quinquefasciatus* (n=764) was the most abundant species followed closely by *Cx. pseudovishnui* (n=721). The other common *Culex* species were *Cx. vishnui*, *Cx. tritaeniorhynchus* and *Cx. gelidus*. All these have been incriminated as Japanese encephalitis vectors in peninsular Malaysia (Vythilingam *et al*., 1995). *Culex quinquefasciatus* generally is a nuisance mosquito in Malaysia and breeds in polluted water bodies such as drains, septic tanks, unused wells, storm water canals etc.

Among the *Mansonia* species collected during the survey, *Ma. uniformis* was the predominant species (79.0%). *Mansonia uniformis* is an important vector of subperiodic *Brugia malayi* in Peninsular Malaysia (Ramachandran *et al*., 1970). It breeds in open swamps and ponds with aquatic plants such as water hyacinth and water lettuce. Other *Mansonia* species present in much lower numbers were *Ma. dives* (16.7%), *Ma. indiana* (3.2%) and *Ma. annulifera* (1.1%).

Among the *Aedes*, *Ae. vexans* was the dominant species (n=575), followed *by Ae. albopictus* (n=75) and *Ae. poicilius* (n=26). *Aedes vexans* breeds in unshaded pools and ditches in salt, brackish and fresh water (Cheong *et al*., 1988). It feeds mainly on cattle but readily attacks man. It has not been incriminated as a vector in Malaysia. Nevertheless, nematode infections of unknown origin have been found in *Ae. vexans* in Pondok Tanjung, Perak, peninsular Malaysia and in Bengkoka, Sabah (Cheong *et al*., 1988). *Aedes albopictus* is one of the commonest *Aedes* species in Malaysia. It occurs in all ecotypes in towns, villages, forest fringe and coastal areas and in a wide variety of breeding places from tree holes to domestic containers. It is also known to be a vector of dengue in Malaysia. Only 3 specimens of *Ae. alboscutellatus* and 1 specimen each of *Aedes flavipennis* and *Aedes lineatopennis* were collected throughout the study period. Overall, more specimens of *Aedes* species were collected in November.

Armigeres (Leicesteria) group was presen in this collection. However, very low number of *Armegers* species were collected in the study area.

Biting mosquito composition and human contact by these species are important factors in determining nuisance level and possible disease transmission. People are likely to be motivated to use personal protection and other control methods when biting mosquito densities are high. Studies on the ecology of the diverse mosquito species identified within the study area, including their relationship with land cultivation, their host preference and their potential to transmit diseases will also provide useful information for vector control activities.

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