

## Seasonal prevalence of malaria vectors and its relationship with malaria transmission in three physiographic zones in Uttaranchal state, India

R.P. Shukla<sup>a</sup>, S.N. Sharma<sup>b</sup> & R.C. Dhiman<sup>a</sup>

<sup>a</sup>National Institute of Malaria Research (ICMR), Delhi; <sup>b</sup>Integrated Disease Vector Control Project (Field Unit), Raipur, India

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*Anopheles minimus* (Diptera : Culicidae) has been reported as a principal malaria vector in district Nainital<sup>1</sup>. *An. fluviatilis* and *An. culicifacies* (Diptera: Culicidae) were later incriminated as malaria vectors and *An. minimus* was reported virtually absent<sup>2–4</sup>. Recently, in forest ecotype, *An. fluviatilis* has been incriminated as malaria vector and its sibling species ‘S’, which is a potential vector of malaria, was recorded for the first time in this area<sup>5</sup>. The data collected from District Malaria Office for the years 1998 and 1999 revealed that the annual parasite incidence (API) and slide positivity rate (SPR) was 0.2 and 0.3, and 1.0 and 1.1, respectively in Nainital and 1.0 and 0.6, and 1.3 and 1.0, respectively in Udham Singh Nagar districts. The transmission dynamics of malaria in such geographical zones is also likely to differ requiring specific vector control strategies. Therefore, the present study was undertaken in three different zones in Kumaon region such as hilly, *bhabar* (foothill area with very low water table) and *terai* (plain area with high water table) zones from April 1998 to March 1999 to study the seasonal prevalence of vectors and parasite load in the community.

One village in each physiological zone was selected for the pilot study. Hilly zone is characterised by sedimentary and igneous rocks with streamlets and lakes. Mehra Gaon village with a population of 1431 per-

sons, situated at an altitude of 4500 ft was selected from hilly zone. The *bhabar* zone is characterised by very low water table containing porous substratum with dispersed settlements. The village Sultan Nagri with a population of 524 persons, located in the foothill in forest fringe was selected. *Terai* zone is characterised by plain area, low-lying with high water table, wet and swampy land with high agriculture yield. Chhattarpur village having a population of 785, with few brick-made houses and inhabitants mostly agriculturists, was selected.

Mosquito collections were made from five catching stations (5 human dwellings and 5 cattlesheds) in each village by hand capture method from 0600 to 0800 hrs from indoor resting habitats, fortnightly. Percentage composition of the anophelines in three different physiographic zones, per man hour density (MHD) and abdominal condition of vector species were recorded. Fever surveys were conducted monthly in each study village and the treatment was given as per National Vector Borne Disease Control Programme (NVBDCP) policy.

A total of nine anopheline species, i.e. *An. culicifacies*, *An. fluviatilis*, *An. annularis*, *An. nigerrimus*, *An. subpictus*, *An. vagus*, *An. barbirostris*, *An. splendidus* and *An. maculatus* were collected from different physiographic zones. Out of these, *An. nigerrimus*

and *An. barbirostris* from hilly and *An. barbirostris* from *bhabar* and *An. maculatus* from *terai* zones were not recorded during the study. The percentage composition of anopheline species in different physiographic zones are given in Table 1. Human blood index study against *An. culicifacies* and *An. fluviatilis* could not be made during the present study, however, the HBI study has already made earlier from this region<sup>5</sup>.

Man hour density of vector species from the three physiographic zones are given in Fig. 1. Highest densities of *An. culicifacies* were recorded in monsoon months, i.e. July to September in all three zones. *An. fluviatilis* prevalence was high during pre-monsoon period in hilly zone and during pre- and post-monsoon period in *terai* and *bhabar* villages. Thus, the prevalence of both vector species was inverse to each other.

The percent proportion of unfed (UF), fullfed (FF), semigravid (SG) and gravid (G) condition of vector species were recorded. In Mehra Gaon (hilly zone) the above proportion was 3.1, 53.1, 31.3 and 12.5 of *An. culicifacies* and 6, 64, 20 and 10 of *An. fluviatilis*,

**Table 1. Percentage composition of anophelines in hilly, bhabar and terai zones of Kumaon region, Uttranchal**

Anopheline species	Percentage composition					
	Hilly		Bhabar		Terai	
	No.	%	No.	%	No.	%
<i>An. culicifacies</i>	32	20.0	228	68.3	257	44.0
<i>An. fluviatilis</i>	50	31.3	56	16.8	35	6.0
<i>An. annularis</i>	13	8.1	1	0.3	91	15.6
<i>An. nigerrimus</i>	0	0.0	1	0.3	1	0.2
<i>An. subpictus</i>	12	7.5	21	6.3	163	27.9
<i>An. vagus</i>	5	3.1	12	3.6	35	6.0
<i>An. barbirostris</i>	0	0.0	0	0.0	1	0.2
<i>An. splendidus</i>	3	1.9	2	0.6	1	0.2
<i>An. maculatus</i>	45	28.1	13	3.9	0	0.0
Total (1078)	160	14.8	334	31.0	584	54.2

respectively. In Sultan Nagri (*Bhabar* zone) the UF, FF, SG and G proportion was 4.4, 50, 39.5 and 6.1 of *An. culicifacies* and 4.5, 44.8, 32.8 and 17.9 of *An. fluviatilis* respectively, while in Chhattarpur (*Terai* zone) this proportion was 15.2, 36.6, 27.2 and 21 of *An. culicifacies* and 14.3, 42.9, 17.1 and 25.7 of *An. fluviatilis*, respectively. The results of the study revealed that both the vectors showed endophilic behaviour.

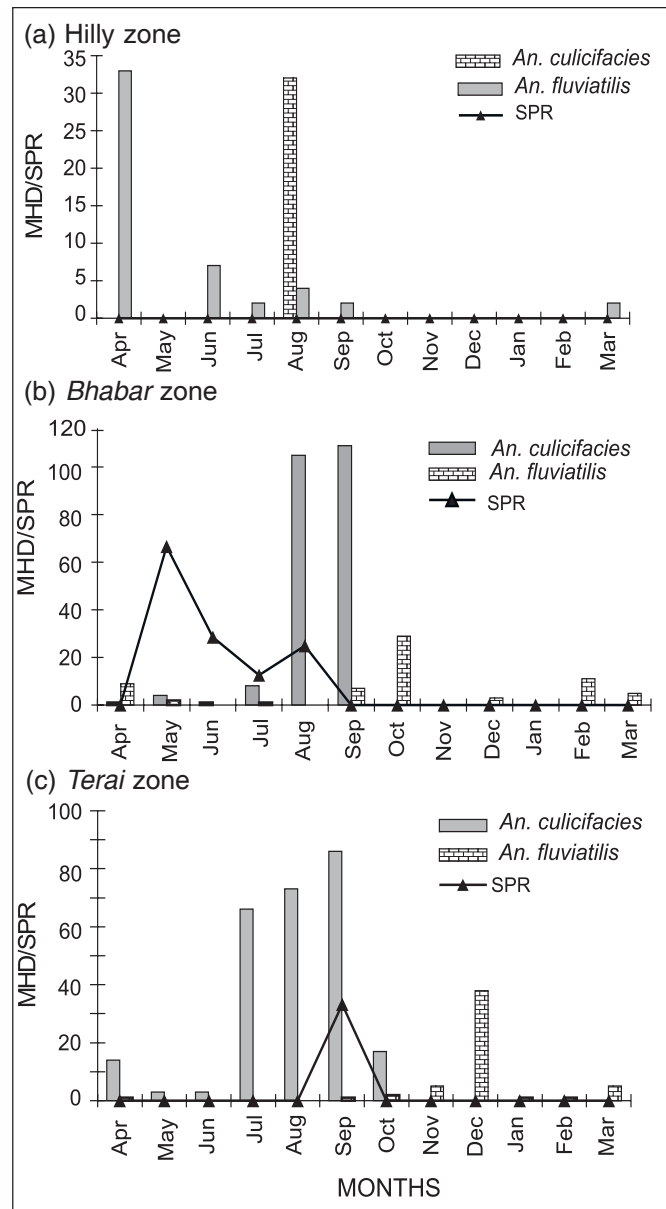


Fig. 1: Vector density and SPR in three physiographic zones of Kumaon region, Uttranchal state

In Mehra Gaon, a total of 17 blood slides were examined during the year but none was found positive for malaria. In Sultan Nagri, out of 79 blood slides examined 12 were found positive for *P. vivax* with high incidence (66.7%) in May. Age and sex wise data on malaria revealed one male in 0–1 yr, two males and one female in 9–14 yr and five males and three females in 26–50 yr age groups. In Chhattarpur, only one was found positive for *P. vivax* during September (Fig. 1). This reflects high malaria in *bhabar*, low in *terai* and no malaria in hilly zone.

Keeping in view the occurrence of malaria cases vis à vis MHD of *An. culicifacies* and *An. fluviatilis* from April to September it appears that in *bhabar* zone both the above vectors are playing role in transmission of malaria. Migration in the village Sultan Nagri was restricted to Haldwani revealing no imported malaria whereas there might be relapse cases. However, age and sex wise data of infants revealed active transmission (indigenous malaria) in *bhabar* zone. It may be further corroborated by the detection of sporozoites in *An. fluviatilis* from *bhabar* area<sup>5</sup> and recently in *An. culicifacies* by us. In *terai* zone, though *An. fluviatilis* was found in high density in December, no malaria case was recorded. Therefore, in the present study, in *terai* zone, *An. fluviatilis* had no role whereas *An. culicifacies* played role in malaria transmission as also proved earlier<sup>6</sup>. In hilly village, no malaria case was detected during the course of investigation that might be due to low temperature (average 15°C) and relative humidity (average 59.3%) whereas in other two areas—*bhabar* and *terai* the average temperature ranged from 23 to 30.9°C and average relative humidity varied from 65.2 to 69.8% might be favourable for development of parasites in mosquito and infected man.

In view of the changing ecological scenario and consequent risk of malaria transmission on the preva-

lence of malaria vectors and its relationship in transmission of malaria in *bhabar* and *terai* it is possible that vector species which were wide spread in *terai* zone might have shifted to forest area of *bhabar* zone<sup>5</sup> due to deforestation and extensive agricultural practices. The finding of difference in prevalence of *An. culicifacies* and *An. fluviatilis* in three different zones of Nainital and Udham Singh Nagar districts, the reconsideration of time of insecticidal spray from 15 May (first round) and second round from August month is warranted in the areas with more than 2 API.

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Corresponding author: Dr. R.P. Shukla, National Institute of Malaria Research, 2 Nanak Enclave, Delhi–110 009, India.  
E-mail: shukla@icmr.org.in; drshukla@yahoo.co.in

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