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# Seasonal prevalence of malaria vectors in Sonitpur district of Assam, India

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Mosquitoes apart from a biting nuisance, are responsible for transmitting diseases like malaria, filariasis, dengue, dengue haemorrhagic fever, etc. Malaria is one of the most formidable and serious public health problems in northeastern region (NE) of India in general and Assam in particular[1]. Stable malaria with preponderance of *Plasmodium falciparum* infection (60–90%) is the main characteristic of the disease pattern in the NE region. Difficult terrain, hilly forests, inadequate infrastructure coupled with the development of chloroquine resistance in *P. falciparum* in Assam[2] is aggravating the situation.

Information on the population dynamics of mosquito vectors, seasonal prevalence, preferential breeding habitats, behaviour is critical for developing control strategies. Environmental changes have a great bearing on larval habitats of different species of mosquitoes that influence adult population density[3]. Keeping all these in view a detailed survey was carried out in four areas of Sonitpur district, Assam to collect information on the seasonal incidence/prevalence, species composition and distribution of malaria vectors.

The study on seasonality of malaria vectors was carried out in Lama Camp, Hoograjuli, Behali and Pabhoi areas in different physiographic zones of Sonitpur district, Assam. The Sonitpur district with an area of 5324 km$^2$ is situated on the northern bank of the Brahmaputra River (longitude of 92º 20'E to 93º45'E and latitude of 26º20'N to 27º05'N) and bound by Arunachal Pradesh to the north, Brahmaputra River to the south, North Lakhimpur and Darrang districts to the east and west, respectively. The climate of the district is warm, subtropical, the summer and the winter temperature vary from 7 to 36ºC. The average annual rainfall ranges between 170 and 220 cm. Hot and humid climatic conditions, paddy fields, annual/perennial slow flowing streams, channels, irrigation drains, ditches, ponds, etc. provide favourable breeding habitats for vector mosquitoes in this district. The villages of the four study areas are thinly populated and inhabited mainly by Assamese, Bodo, Karbi, Garo, Bengalese, Nepalese and ex-tea garden labourers (*Adibashis*).

Lama Camp and Hoograjuli areas under Dhekiajuli PHC are located in foothills bordering Arunachal Pradesh. Behali under Behali PHC is located in the plain sylvan area while Pabhoi area under Biswanath Charali PHC is surrounded by tea gardens. Adult mosquitoes were collected from dusk-to-dawn using CDC miniature light-traps in both human dwellings (HD) and cattlesheds (CS) from March 2002 to February 2003. The study period was grouped into four seasons, such as pre-monsoon (March to May), monsoon (June to August), post-monsoon (September to November) and winter season (December to February). Four trap night collections of mosquitoes (two from HD and two

from CS) in each study area in every month were done in all the selected villages. Trapped mosquitoes were identified using standard keys[4,5]. Densities of malaria vectors of all the study places were expressed in terms of mean numbers caught per trap night.

A total of 10,502 female anophelines, representing seven species were trapped. Highest number of malaria vectors was recorded from Lama Camp (n = 2606) followed by Hoograjuli (n = 4265), Behali (n = 2160) and lowest in Pabhoi (n = 1471) areas. Out of the nine known malaria vector species of India, seven species, *Anopheles annularis* (Diptera: Culicidae), *An. culicifacies, An. dirus, An. fluviatilis, An. minimus, An. philippinensis* (*An. nivipes*) and *An. varuna* were captured at varying densities depending on season (Fig. 1). *An. philippinensis* (*An. nivipes*) predominated in all the four study areas comprising 40.3% (4,227/10,502) of the total malaria vectors followed by *An. annularis* (26.7%), *An. minimus* (14.5%), *An. culicifacies* (12.2%), *An. fluviatilis* (2.8%), *An. dirus* (1.9%) and *An. varuna* (1.6%). Density of *An. philippinensis, An. annularis, An. minimus, An. culicifacies* and *An. dirus* started increasing during the pre-monsoon period, peaked in monsoon and declined during post-monsoon. Highest numbers of *An. varuna* were collected during pre-monsoon and post-monsoon periods and low in monsoon and winter months. Highest collection of anophelines was made in CS (72.1%) than HD (28%) except *An. dirus*, which was encountered more in human dwellings (Fig. 2). *An. dirus* was found prevalent only in Lama Camp with population peak during the monsoon season and was absent during the winter. *An. varuna* was captured in Lama Camp and Behali areas only with population peaks in pre-monsoon (Lama Camp) and post-monsoon (Behali) periods. Density of *An. fluviatilis* increased during the drier period of the year, from post-monsoon to pre-monsoon periods. This species was not recorded during monsoon months in any of the study areas. Highest overall density of malaria vectors was recorded during the monsoon period followed by post- and pre-monsoon, and lowest in winter.

The results of the studies revealed that the densities of malaria vectors are influenced by rainfall pattern,

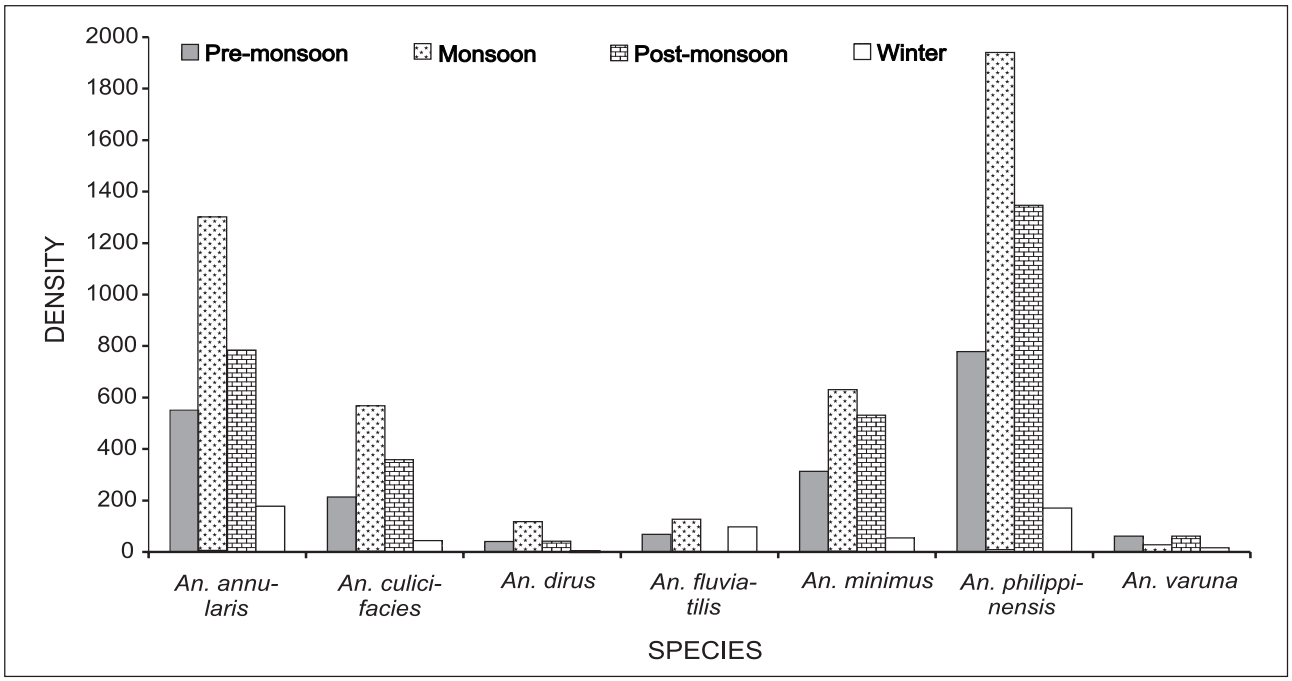


*Fig. 1:* Seasonal density of malaria vectors in Sonitpur district, Assam

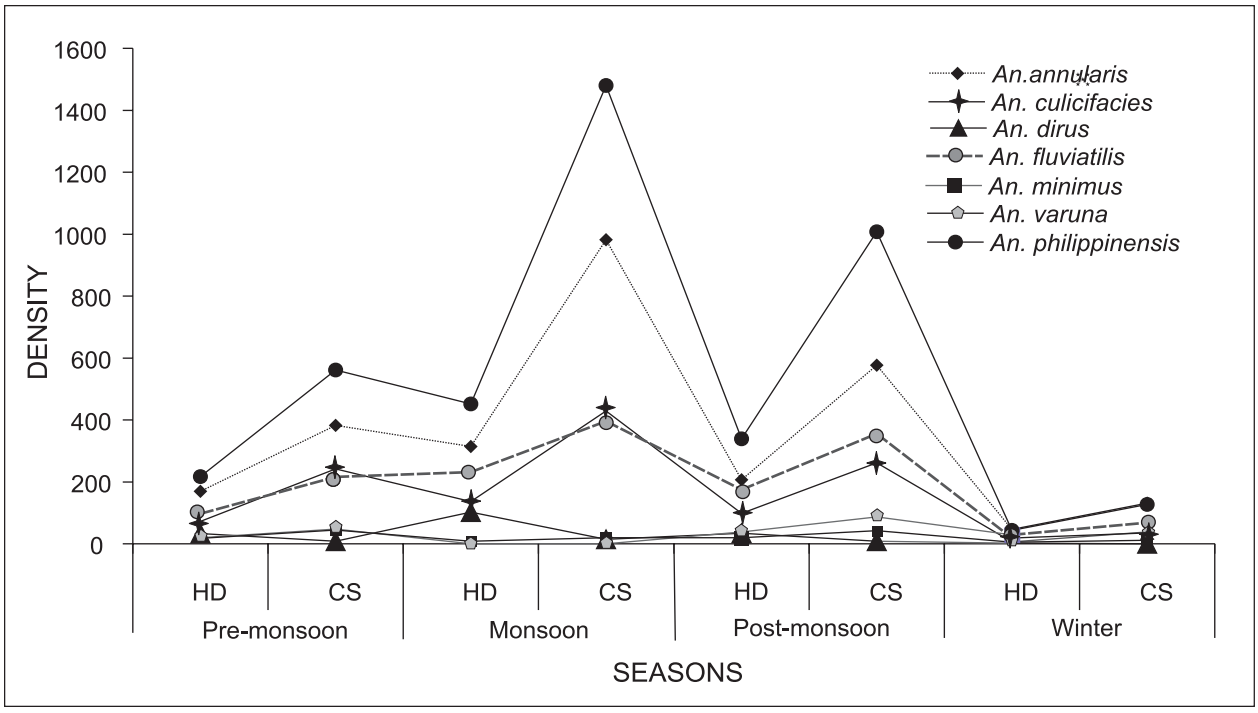


*Fig. 2:* Seasonal density of malaria vectors in Sonitpur district, Assam

started increase from the beginning of the rainy season (March–May) with peak densities towards the end of rainy season (July–August) for most anophelines except *An. fluviatilis* that showed high densities in the winter months. This occurrence is likely due to increase in the number of larval habitats after the rains subside.

Higher densities of *Anopheles* vector mosquitoes were sampled from Hoograjuli area followed by Lama Camp, Behali and lowest in Pabhoi area. This was attributed to variability in rainfall, temperature and suitable larval habitats. Large seasonal variation of *Anopheles* mosquitoes was found in all the study areas. The number of malaria vectors was highest during wet monsoon season than in dry winter months except *An. fluviatilis*. In the present study, two population peaks of *An. culicifacies* were observed, one during June–July in Lama Camp, Hoograjuli and Behali and another during September–November in Pabhoi area. Similarly, Sharma & Prasad[6] observed two population peaks of *An. culicifacies*, one during March to June and another during October–December in Shahjahanpur, Uttar Pradesh; Das *et al*[7] during June–July and the second during February–March in a study carried out in Koraput district of Orissa; and Kulkarni[8] during February and July for *An. culicifacies,* while *An. fluviatilis* was found throughout the year. Bimodal peak of *An. culicifacies* in different seasons may be due to rainfall pattern, availability of breeding habitats and physiographic location.

In the present study, the peak density of *An. fluviatilis* was observed in the post-monsoon months (September–November) at Hoograjuli, Behali and Pabhoi areas and during winter months in Lama Camp but was absent from all sites during the monsoon months (June–August). Similar observation was also reported from NE region of India[9], Koraput district of Orissa[7] and in Rajasthan[10]. *An. dirus* was recorded from Lama Camp area only and the abundance was observed throughout the study period with population peak in monsoon season. Prakash *et al*[11] also reported distinct seasonality of *An. dirus* with high densities

in July and very low numbers during cool winter dry months.

*An. minimus*, which is a species of hill and foothills occupying ecotone zones, closure to the forest is being considered as the major vector of malaria in NE region of India. In the present study, this species was found prevalent throughout the year with maximum abundance during monsoon and post-monsoon period with a peak during July–October in different agro-climatic conditions of the study areas, which confirms earlier observations made by Dev *et al*[12] in different districts of Assam. Similarly, *An. minimus* was found more abundant during the wet season compared with the dry and hot seasons in a study carried out in Thailand by Chareonviriyaphap *et al*[13].

*An. varuna* showed different prevalence patterns in the study villages that may be due to difference in environment and ecological factors. However, densities of *An. varuna* and *An. annularis* were recorded maximum in winter (January–February) and early summer (March–April) in Koraput district of Orissa[7]. Similarly, Tiwari *et al*[14] reported the prevalence of *An. varuna* only during winter season from stone quarry area of District Allahabad.

In the present study *An. philippinensis* (*An. nivipes*) and *An. annularis* were found prevalent throughout the year with varying densities in all the study areas with peak during July–September, which confirms the earlier observations made by Malhotra[15] in Tezpur and Howraghat of Assam; and Kareem *et al*[16] in Kamrup district of Assam. Similarly, Rao[17] in Bengal and southern India reported abundance of *An. annularis* throughout the year with highest during May–June. It may be concluded that both *An. philippinensis* (*An. nivipes*) and *An. annularis* are mostly monsoon mosquitoes.

High density of malaria vectors in CS than HD in the present study indicated their zoophagic nature because of the presence of large number of domestic animals in the villages except *An. dirus,* which was trapped highest in HD. Similarly, significantly high density of anopheline mosquitoes in CS than in HD in all the seasons in District South 24-Paraganas, West Bengal was reported by Tandon & Tandon[18]; and in Darjeeling district by Malakar *et al* [19].

Outcome of the results on seasonal abundance of malaria vectors in four different geographical areas of Sonitpur district, Assam would improve our understanding of the patterns of malaria transmission and the role of vector species in malaria transmission. The information on the seasonal prevalence of malaria vectors may pave the way for designing appropriate vector control strategies.

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