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Reappearance of *Anopheles minimus* in Singhbum hills of East-Central India

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Abstract

Anopheles minimus, an important malaria vector of South East Asia, has reappeared in the Singhbum hills, East-Central India where deforestation and DDT residual spraying had reportedly eliminated it during the Malaria Eradication Programme. The species reported has been identified as sibling species A of the *An. minimus* complex. *An. minimus* is susceptible to both deltamethrin and DDT. The study shows that the environmental conditions in this region still favour the existence of the species and one of the possible reasons for its reappearance may be the scaling down of residual insecticide spraying in the area.

Keywords: *Anopheles minimus*; Malaria vector; Reappearance; Susceptibility, Orissa, India

1. Introduction

Anopheles minimus is widely distributed in the oriental region and is known to occur in India, Nepal, Bangladesh, Sri Lanka, Thailand, Myanmar, Malaysia, Indonesia, southern China, Hong Kong, Taiwan and the Ryukyu Islands (Rao, 1984). Throughout its range of distribution, it was an important malaria vector. In India, it was one of the primary vectors of malaria all along the foothills of the Himalayas extending from the Terai region of Uttar Pradesh to Assam and the neighbouring eastern region. In East-Central India (Jeypore and the Singhbhum hills), sporozoite rates ranging from 4.3 to 15.4% were reported in this species (Rao, 1984). The introduction of DDT in 1958 for malaria control and the ecological changes due to extensive deforestation caused several changes in its distribution. The *An. minimus* population declined in numbers or completely disappeared from the Terai region of Uttar Pradesh, East-Central India and also in large parts of Assam (Kalra, 1991). While several studies conducted in the 1970s and 1980s have confirmed its continuous presence in West Bengal and the North Eastern states as the major vector (Nandi et al., 2000; Kamal and Das, 2001; Prakash et al., 2000; Dev et al., 2001), the species was not any more encountered in other regions (Rao, 1984; Dash et al., 1984; Gunasekaran et al., 1989; Collins et al., 1990; Kalra, 1991; Sharma,

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2002). Recently, Das et al. (2000) recorded *An. minimus* in the Rajamahal range in Bihar (Northern India). We report in this communication, the reappearance of *An. minimus* in the Singhbum hills, East-Central India, where this species has been reported to be absent for nearly 45 years after the launching of the Malaria Eradication Programme.

2. Materials and methods

2.1. Study area

The study was carried out in Keonjhar district (latitude 20°11′ to 20°10′N, longitude 85°11′ to 86°22′) of Orissa state during 2001–2003. The district is divided into 13 administrative blocks or Primary Health Centre areas. It is spread over an area of 8303 km^2 of which about two-third is traversed by the Singhbum hill range with 30–40% of the area under forest cover. A population of approximately 1.5 million (according to 2001 census) is distributed in 2118 villages. Tribes constitute about 44.5% of the population.

The climate is characterized by a hot summer (March–June), a rainy (July–September) and a cool season (October–February). The minimum temperature ranges from 8 °C in December to 32 °C in May and the maximum temperature ranges from 19 °C in December to 42 °C in May. Malaria has been endemic in this district and the majority (>95%) of the cases are caused by *Plasmodium falciparum*. During 1997–2002, malaria incidence in the district has shown an increasing trend with the annual parasite incidence (API) ranging from 31.8 to 36.3. There were 119 malaria deaths in the district in 2000 and 82 in 2001 (compared to 442 and 305, respectively, in Orissa state). The number of deaths in Keonjhar in 2000 accounted for about 20% of the total number of malaria deaths (522) recorded in India.

Since 1958, the district has been under DDT residual spraying. Under the modified plan of operation implemented in 1977, the district continued to receive DDT residual spraying, since in all the areas, >2 API were recorded. From 1981 onwards, the areas receiving DDT spray started reducing depending on the availability of DDT stock and funds for spray operations. The population targeted for protection using DDT spray ranged from 14 to 84% during 1981–1990 and from 12 to 66% during 1991–2000. During the latter period, only seven first rounds and three second rounds of spraying were carried out in the district. Priorities were given to the areas, where cerebral malaria and malarial deaths were reported. In view of persistent transmission, the district has been included under the Enhanced Malaria Control Programme in 1998 and from 2001 onwards, pyrethroids (lambdacyhalolthrin, alphacypermethrin or cyfluthrin) have been used for residual spraying in place of DDT in 11 of the 13 PHC areas (where API > 10). Since malaria incidence peaks during July–August and November–December, two rounds of spraying have been carried out during May–June and September–October, respectively. During the last 3 years (2001–2003), the population protected varied from 9 to 84%.

2.2. Entomological collections

The first entomological survey of this series was made in August 2001 in Keonjhar district of Orissa state. *An. minimus* was recorded during the survey along with the other known malaria vector of the area, *Anopheles fluviatilis*. The presence of *An. minimus* prompted the performance of four more surveys during 2003–2004, one in the summer (March–April 2003), one in the rainy season (August–September 2003) and two in the cold season (October 2003 and February 2004). Surveys were made in five hilltop villages, viz. Doyonala, Dhanakunia Sahi, Lohanda, Mundasahi and Ulupuri, randomly selected from the Banspal, Basudevpur and Joda PHC areas, respectively, where a high incidence of malaria was recorded during 1999–2001. Day time indoor resting adult anophelines were collected using aspirators and torch lights between 06:00 and 07:00 h in nine human dwellings and three cattle sheds selected randomly in each village. A modified version of the CDC light trap (Gunasekaran et al., 1994) was installed in two human dwellings and two cattle sheds in a village (one trap in one structure) from 18:00 to 06:00 h. Man-landing collections were made between 18:00 and 21:00 h at three catching stations in each village. The anophelines collected were identified morphologically according to species and the species composition was recorded. Females of *An. fluviatilis*, *An. minimus* and *Anopheles culicifacies* were dissected for gut and gland infection with *Plasmodium*.