Geographical Spread of Anopheles stephensi, Vector of Urban Malaria, and Aedes aegypti, Vector of Dengue/DHF, in the Arabian Sea Islands of Lakshadweep, India

by
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Abstract

The Indian islands of Lakshadweep in the Arabian sea are known to be endemic for bancroftian filariasis. However, malaria endemicity was reported to be associated with the invasion of vector species Anopheles tessellatus from Maldives. Indigenous transmission of malaria was recorded during 1972. Thereafter the National Anti-Malaria Programme (NAMP) brought these islands under DDT spray. Since 1981, only imported cases of malaria are being reported from these islands. During March 2000, a brief survey of two islands, viz. Agatti and Kavaratti, revealed the presence of Anopheles stephensi, a known vector of urban malaria in the country. Earlier on the mainland, the southward peninsular spread of An. stephensi, including in Kerala, a non-malarious state, was recorded and the species was reported to be involved in two major outbreaks of malaria. It appears that over the years An. stephensi has invaded the Lakshadweep islands and gained a permanent foothold on these islands due to the availability of a large number of community and rain-harvesting cement storage tanks. These developments also threaten the northern islands of Maldives which are about 90 km south of Lakshadweep, where water storage practices are identical. Aedes aegypti which was earlier detected in the neighbouring group of Minicoy islands during 1974, has now spread widely in all the islands and poses an imminent threat of DF/DHF epidemics.

Keywords: Geographical spread, dengue, malaria vectors, Aedes aegypti, Anopheles stephensi.

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Introduction

Lakshadweep, the smallest Union Territory (UT) of India, is a group of 36 islands, of which 10 are inhabited. These are: Androth, Agatti, Bitra, Chetlet, Kadamath, Kalpeni, Kavaratti, Kiltan and Minicoy. These islands are a narrow strip of land, 3-4 metres above the mean sea level, and lie in the Arabian Sea about 220-440 km away from the Kerala coast of India at between 8° and 12° North latitude and 71° and 74° East latitude. The total land area of these islands is about 32 sq km, out of which about 26.32 sq km is in use. As per the 1991 census, the total population of the Lakshadweep islands was 51,681. The main occupations of the islanders include coconut cultivation, production of coir, fishing, etc.

The Lakshadweep islands are endemic for bancroftian filariasis and malaria\(^1\). Filariasis is endemic practically in all the islands, primarily as a socioeconomic problem related to the coir industry, as coir soakage pits heavily breed Culex quinquefasciatus mosquito, the vector of Wuchereria bancrofti. Malaria in these islands is unstable and sporadic\(^2,3\), depending upon the presence of the vector species. However, an analysis of the epidemiological data revealed that filariasis and malaria infections were showing declining trends, the former due to the introduction of DEC-medicated salt therapy during 1976-79\(^5\) and the large-scale introduction of mosquito larvivorous fishes, such as Gambusia affinis and Poecilia reticulata during 1980 and the latter due to the effective implementation of the National Anti-Malaria Programme (NAMP), ensuring early detection and prompt treatment of all malaria cases through active and passive surveillance. During 1997-99, only four imported cases of Plasmodium vivax were reported from these islands.

During March 2000, Agatti and Kavaratti islands were visited to ascertain the current status of malaria and filariasis and to collect information on the prevalence of the vectors of malaria, filariasis and DF/DHF. The findings of this brief survey are presented in this communication.

Materials and methods

Larval collections were made using a ladle, larval net, well net and a pipette. The larvae collected from Kavaratti were preserved in 70% alcohol, mounted in Bhatia’s medium and identified at the larval stage; however, larvae collected from Agatti were transported live in polythene bags containing water from the breeding sites to the laboratory at the National Institute of Communicable Diseases (NICD), Delhi. The mosquito larvae were kept for rearing in an insectory having an ambient temperature of 27±1°C. Brewer’s yeast was provided as food. The adults (emerged) were mounted, preserved and identified using standard identification keys\(^6,7\).

Results

The analysis of the data collected revealed the presence of five mosquito species, viz. An. stephensi (type form), An. varuna, Cx. quinquefasciatus, Ae. aegypti and Ae.
albopictus. The breeding habitats of these species are shown in the table.

**Table.** Breeding habitats of various mosquito species observed in Agatti and Kavaratti islands of Lakshadweep

<table>
<thead>
<tr>
<th>Mosquito species</th>
<th>Breeding habitats</th>
</tr>
</thead>
<tbody>
<tr>
<td>An. stephensi</td>
<td>Small cement tanks containing clean/turbid water attached to mosques/community lavatories</td>
</tr>
<tr>
<td>An. varuna</td>
<td>Draw wells with clean water</td>
</tr>
<tr>
<td>Cx. quinquefasciatus</td>
<td>Coir soakage pits, rainwater harvesting tanks</td>
</tr>
<tr>
<td>Ae. aegypti</td>
<td>Small cement tanks, used tyres, solid waste material holding rain water</td>
</tr>
<tr>
<td>Ae. albopictus</td>
<td>Small pots holding drinking water for birds, metallic containers holding rainwater collection and tree holes</td>
</tr>
</tbody>
</table>

**Discussion**

Lakshadweep islands being flat coral islands just 2 to 3 metres above the mean sea level are devoid of any natural breeding sites like streams, swamps and marshes, restricting the diversity of mosquito fauna. Only those mosquito species have become endemic which can afford to breed in man-made breeding sites. This explains why only a few mosquito species could become endemic, inspite of invasion from the neighbouring coastal states of Kerala and Karnataka on the mainland and from Maldives which is just 90 km south of the neighbouring Minicoy island.

Amongst the anopheline species, An. varuna invaded from the Kerala coast and occupied draw-wells as their breeding sites. An. tesselatus was introduced from Maldives and spread to other islands and maintained low-grade transmission; however, these species failed to gain a foothold. The spontaneous disappearance of malaria from Minicoy island was attributed to this phenomenon. Similarly, An. varuna failed to initiate malaria transmission on these islands.

Earlier, it was observed that A. stephensi (type from), the vector of urban malaria, had shown a southward geographical spread on the Indian mainland due to rapid urbanization and water storage practices. During the 1970s, the species invaded Goa on the western coast and Kanyakumari on the tip of the southern coast in the 1980s. The species finally entered Kerala and contributed to the malaria outbreak during 1996 at Vialiathura near Thiruvananthapuram airport, where over 100 cases of malaria were recorded. This was followed by another outbreak in Kasargod during 1998 when 405 cases and three deaths were reported. In both these outbreaks, An. stephensi was found to be involved in the disease transmission (Source: NAMP). Prior to this, Kerala state had never reported indigenous malaria cases for decades. On the basis of the observations made, it is felt that littoral countries to the south of India, such as Maldives and Sri Lanka, are also at great risk and are required to undertake stringent measures at their airports and seaports as per the International Health Regulations to prevent the entry of this species.(8,9).

The invasion of Lakshadweep islands by An. stephensi is a very serious development. Being a container-breeding species, it fits
well with the social and cultural habits of the communities like water storage in small cement tanks, rainwater harvesting tanks, etc. Frequent outbreaks of malaria in different towns of Kerala and high trade traffic between Kerala and these islands will provide a fillip to the indigenous transmission of malaria.

The establishment of An. stephensi poses immediate threat not only to the Lakshadweep islands but also to the adjoining Maldives via the same route (country sailing vessels) as the Maldivian species (An. tesselatus and An. subpictus), once found their way to Lakshadweep.

The establishment of Ae. aegypti, the vector of DF/DHF, is yet another serious development; the presence of this species was originally recorded in Minicoy islands in 1974(3), which has now invaded the other islands of Lakshadweep, posing imminent threat of DF/DHF outbreaks.

Cx. quinquefasciatus is already an endemic species breeding in the coir soakage pits, an essential industry tied to the economy of these islands.

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References