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Research Article

ENTOMOLOGICAL SURVEILLANCE FOR THE VECTOR OF YELLOW FEVER/DENGUE/CHIKUNGUNYA IN AND AROUND PORTS OF GOA, INDIA

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ABSTRACT

As per the International Health Regulations it is moral responsibility on national governments to keep international seaports/airports and peripheral areas up to 400 metres free of vector mosquitoes in its adult and immature stages and the mosquito vectors of other diseases of epidemiological significance. In view of seriousness of the problem, present study was undertaken in and around port areas of Goa (India) to see the prevalence of *Aedes* mosquito. At seaport area, 83 containers were found positive with 46.4 per cent container index. At airports, breeding of *Aedes* mosquito could not be detected, however, *Culex* larvae were detected at one place. In adjoining residential colonies near Mormugao port Trust (MPT), higher container index was found to be in Roomrawala Chal (25.8 percent) and Breateu index in Headland Upper Sada (56.3). Plastic containers were the preferred source of breeding followed by tin and tires. In MPT campus high density of adult *Aedes* (*Stegomyia*) *albopictus* (*Skuse*) (*Diptera: Culicidae*) was noted with 78.0 Per Man Hour Density (PMHD). Breeding preference ratio (BPR) was highest for tires (1.5) in Mormugao Port Trust area while in residential colonies highest for earthen (4.8). In the present study high vector indices were recorded in both the port area surveyed. Health authority of airport/seaport need to develop action plan for appropriate control measures with emphasis on vector surveillance.

Keywords: *Aedes albopictus*, Dengue, Breeding Preference Ratio, Goa, India.

INTRODUCTION

In recent years, the rate of introductions of invasive mosquito species to new geographic locations has increased rapidly in step with increased international travel and trade and this has had adverse consequences for public health (Gratz, 2000; Vaux *et al*., 2011). Many species of mosquito have become established in new countries, regions, and continents, as a result of anthropogenic transport (Lounibos, 2002). One of the most notable examples is the Asian tiger mosquito (*A. albopictus*) a principal urban vector for the transmission of dengue virus and a competent mosquito vector of 22 arboviruses, including West Nile, dengue and yellow fever viruses (Gubler, 2003). Aedes mosquito is considered a highly domesticated mosquito; highly adapted to living with man, preferring to rest indoors and to feed on humans during daylight hours in an unobtrusive and often undetected manner. The adult female mosquitoes prefer to lay eggs in artificial water containers commonly found in urban areas of tropics and subtropics. Containers commonly found in and around the home, such as those used for water storage, flower vases, old tires, buckets and

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various plastic containers, and other receptacles that collect rainwater are some of the examples. The life cycle of this mosquito is closely associated with human activities and larval habitats are increasing rapidly in urban areas.

This mosquito, originally of Asian origin, has established in America and Africa in the last three decades. More worryingly, it is also establishing in Europe, Albania, France, Italy, Belgium, Switzerland, Greece, Spain, Serbia, Netherlands, Bosnia, and Germany reporting invasions. The transport of mosquitoes beyond their native range *via* shipping, aircraft and transport has been well documented, particularly the expansion of *A. albopictus via* shipping of used tires (Enserink, 2008; Scholte, and Schaffner, 2007) and the occurrence of vectors for yellow fever, dengue, and malaria on aircraft (DeHart, 2003). As a result of rapid transport of *Aedes* mosquitoes, dengue has become one of the fastest growing mosquito-borne diseases in the world with about 20 thousand deaths every year. Since there is no curative treatment for dengue, targeted environmental and ecosystem management is increasingly relevant. Presence and prevalence of mosquitoes in and around ports makes the issues more sensitive. Moreover, under the WHO International Health Regulation (IHR, 2005; WHO, 2008) all international airports and seaports should be kept free from all types of mosquito vector for a distance of 400 meters around the perimeter of the ports to enhance national, regional and global public health security. Present study was undertaken during September, 2011 at port areas of Goa, India, keeping in view of the large traffic at seaport in the form of cargo ships and international flight at airport, because of a favorite destination for domestic/international tourist, thereby likely chances of transportation of vector mosquitoes.

STUDY SITES

Non-residential area

Seaport area: Mormugao port of Goa is one of the oldest ports on the west coast of India with an open type harbour protected by a breakwater and a mole built from the outer end of the breakwater and running parallel to the quay. The harbour is also protected from the South West Monsoon as it has been constructed on the leeward side of Mormugao Headland. It has been relentlessly serving the nation in its economic development for over a century. The Port was declared a major port on 02.12.1963. This port is the premier iron ore exporting port of India with an annual throughput of around 50.02 million tonnes of traffic. Though ore is the predominant cargo, there has been a steady increase in liquid bulk and general cargo traffic ever since its joining the ranks of the major ports of India. The remaining traffic consisted of cargoes like fertilizer, bauxite, containerized cargo, steel slabs, granite, wheat, maize *etc*. During the financial year 2012-2013 the port handled a traffic of 17.69 million tonnes which is 3 percent of the total traffic of 545.79 million tonnes handled by all the twelve major ports of India. This port exported a quantity of 7.42 million tonnes of iron ore in 2012-13 through this port mainly to China, Japan and European countries.

MATERIALS AND METHODS

Airport Area

Goa international airport, more commonly known as Dabolim airport, is an international airport located in the village of Dabolim in Goa. It is the only airport in the state and operates as a civil enclave in a military airbase named INS Hansa. It is 4 km from the nearest city Vasco da Gama, 23 km from the south Goa district headquarters Margao and 30 km from the capital city Panjim. Goa estimated 700 international flights per year account for some 90% of the country's international charter tourist flights. It is estimated that about 150 to 200 thousand international tourists arrive at Dabolim on charter flights. This airport is spread over 688 hectares and consists of a civil enclave of nearly 14 hectares, an increase from its original size of 6 hectares. On an average this port estimated 30-40 flights daily. So, both ports of Goa have enough possibilities to transport not only mosquito

vector but also vector of other diseases of public health importance.

Residential Area

Entomological surveillance was also undertaken in residential colonies around Mormugao port trust. Following colonies were visited:

i. Headland Lower Sada
ii. Headland Upper Sada
iii. Roomrawala Chal

Mormugao port is situated at a latitude 15^{o} 25' N and longitude 73^{o} 47' E. The weather remains cool in Goa in September as the summer season comes to an end. The average temperature was 27°C throughout the month. Highs of up to 29°C are common during the day, cooling down to around 24°C after sunset.

An entomological surveillance for immature and adult mosquitoes was undertaken in and around International airport and seaport of Goa during the post monsoon in the month of September, 2011. Standard entomological techniques were used for survey. Qualitative larval sampling was conducted in all permanent/temporary aquatic habitats. The breeding prevalence of *Aedes* mosquito was detected in diverse breeding containers. All accessible larval breeding habitats like discarded tires, metal drums, plastic drums, other metal containers, plastic buckets, flower pots, mud pots, cement tanks, and other plastic containers were inspected. All live larvae were collected, brought back to the laboratory, where they were reared until adult emergence. Adult mosquitoes emerged from the reared larvae were identified. to assess the breeding potential the data on larval survey were analyzed and calculated in terms of different indices like container index (CI): percentage of water-holding containers infested with larvae or pupae), house index (HI): percentage of houses infested with larvae and/or pupae), breteau index (BI): number of positive containers per 100 houses inspected) as per the WHO procedure (WHO, 1975). The container preferences of *Aedes* breeding were assessed by calculation of breeding preference ratio (BPR) as suggested by Sharma (2002).

RESULTS

In seaport area, a total 179 containers at 30 premises were checked and 83 containers were found positive with 43.3 premises index (PI) and 46.4 container index. In airport area 80 containers at 18 premises were checked. Despite considerable efforts no container was found positive for *Aedes* larvae at airport and only *Culex* larvae were detected in a tin container found opposite main entrance of the airport. Surveillance was also undertaken in the residential colonies near MPT, Goa *viz*. Headland Lower Sada, Headland Upper Sada and Roomrawala Chal. In these areas container index was found to be maximum (25.8 percent) in Roomrawala Chal and minimum (20.5 percent) in Headland Upper Sada, whereas the breateu index was found to be maximum (56.3) in the Headland Upper Sada and minimum (38.0) in Headland Lower Sada (Table 1).

In Mormugao Port Trust out of 179 containers searched, 36.9 percent were plastic followed by tin (22.9 percent), discarded (22.3 percent), tires (13.4 percent) and earthen (4.5 percent). Eighty-three water holding containers were positive for *Aedes aegypti* (Linnaeus) larva with 34.9 per cent plastic followed by tin (26.5 per cent), tires (20.5 percent) and earthen (3.6 percent). In residential colonies 242 containers with water examined, 78.1 percent were plastic followed by tin (12.8 percent), planted pot (3.7 percent) and tires (3.7 percent). A total 54 water holding containers were positive for *A. aegypti* in residential colonies, 51.9 percent plastic followed by tin (27.8 percent), tires (11.1 percent) and planted pot (5.6 percent) (Figure 1). Container preference reflected by the breeding preference ratio (BPR) was highest for tires (1.5) followed by tin (1.2), plastic (0.95) and earthen pot (0.8) in Mormugao Port Trust area while in residential colonies BPR was highest for earthen (4.8) followed by tires (3.0), discarded (2.4) and tin (2.2) (Table 2). The plastic containers were used for holding water for daily use.

Attempt was also made to catch adult mosquitoes and in MPT near civil site office high density of adult *A. albopictus* was noted with 78.0 Per Man Hour Density (PMHD).

Table 1. Entomological surveillance of *Aedes aegypyi* mosquitoes in and around Mormugao Port Trust (MPT), Goa.

Locality	Premises/House			Container			Breateu Index
	Searched	Found Positive	Index	Searched	Found Positive	Index	
Non-residential area							
Mormugao Port Trust	30	13	43.3	179	83	46.4	-
Airport	18	0	00.0	80	0	00.0	-
Residential area near Mormugao Port Trust, Goa							
Headland Lower Sada	50	14	28.0	88	19	21.6	38.0
Headland Upper Sada	32	12	37.5	88	18	20.5	56.3
Roomrawala Chal	44	10	22.7	66	17	25.8	38.6
Total	126	36	28.6	242	54	22.3	42.9

Table 2. Breeding preference ratio (BPR) of *Aedes aegypti* in different artificial breeding habitats in and around Mormugao Port Trust (MPT), Goa.

	Mormugao Port Trust					Residential area near MPT				
Type of breeding habitat	A	X %	B	Y %	BPR (Y/X)	A	X %	B	Y %	BPR (Y/X)
Plastic	66	36.9	29	34.9	0.95	189	78.1	28	51.9	0.66
Rubber tires	24	13.4	17	20.5	1.5	9	3.7	6	11.1	3.0
Tin	41	22.9	22	26.5	1.2	31	12.8	15	27.8	2.2
Planted pot	0	0	0	0	0	9	3.7	3	5.6	1.5
Earthen	8	4.5	3	3.6	0.8	1	0.4	1	1.9	4.8
Cemented	0	0	0	0	0	1	0.4	0	0	0
Discarded	40	22.3	12	14.5	0.65	2	0.8	1	1.9	2.4
Total	179	-	83	-	-	242		54	-	-

A- No. of containers with water. B- No. of containers with larvae.

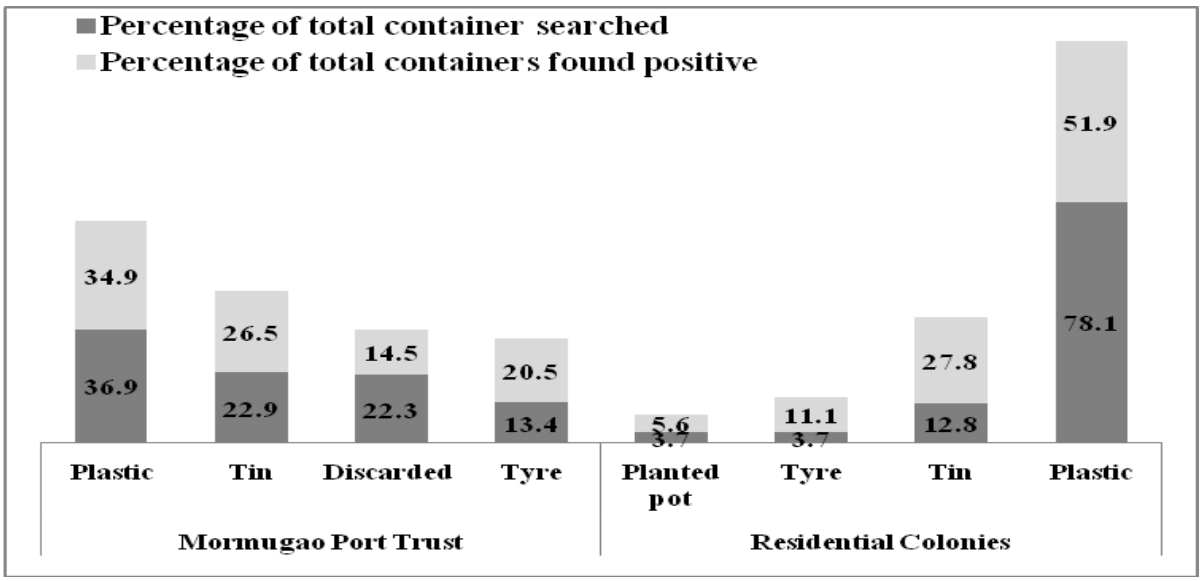

Figure 1. Percentage wise container positivity found during entomological survey in Mormugao Port Trust (MPT), Goa.

DISCUSSION

In view of the expansion of *Aedes* mosquito *via* shipping of used tires (Enserink, 2008; Scholte and Schaffner, 2007), tires were given special attention during surveillance. In MPT campus 70.8 per cent tiers were found positive for *Aedes* larvae. So, different kind of miscellaneous containers (buckets, tires, tin) should remove to avoid the possibilities of spread of larval breeding.

High larval indices and heavy adult density of *Aedes* mosquitoes in and around MPT makes the area vulnerable for transmission of vector and vector borne diseases. This situation necessitated the further strengthening of ecology/entomology based control method. Earlier in India, similar findings were observed at international air and seaport of Kolkata (Das *et al*. 2000), Chennai (Gill *et al*., 2000), Thiruvananthapuram, Kerala (Sharma *et al*., 2004) and Bangalore, Calicut, Chennai, Cochin, Thiruvananthapuram and Vishakapatnam (Sharma *et al*., 2005).

CONCLUSIONS

The threat of introduction of diseases and vectors from one country to another would be reduced if all seaports and airports were kept free of mosquito breeding and rodent infestations, as required by the International Health Regulations. To reduce mosquito populations at ports regular mosquito surveillance should be done to established baseline knowledge of the ports that can be used during subsequent surveys. This kind of entomological surveillance can helps to identify particular habitat types at seaports and airports which are known to support mosquitoes and which could be targeted during further surveys or in the case of the need for mosquito control.

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