



# DIVERSITY OF MOSQUITO IN INDIA : STATUS REPORT

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## ABSTRACT

The present study was conducted to determine the diversity of mosquito species in India.. Mosquito fauna in the world 3700 species belong to 112 genera. In India 393 species of mosquitoes are occurring. The subfamily *Anophelinae* contains 61 species in one genus followed by *Culicinae* with 332 species in 11 tribes and 48 genera. The tribe *Aedini* (subfamily *Culicinae*) contains the highest number of species (176 species in 33 genera and two groups of incertae sedis; i.e., “*Aedes*” *sensu auctorum* and “*Ochlerotatus*” *sensu auctorum*). With the recent taxonomic changes in tribe *Aedini*, the Indian mosquito genera have gone up from 22 to 49. Changes to the Indian *Aedini* fauna subsequent to the reclassification of tribe *Aedini* are discussed. A total of 31 species are currently recognized in India for transmitting various mosquito borne agents of human diseases..Mosquitoes `` important vectors responsible for spreading various diseases in human population. They belong to family *Culicidinae* of order Diptera. Mosquitoes are very efficient vector of human diseases today. Mosquitoes are potential vector of malaria, dengue and other diseases are elephantiasis, lymphatic filariasis etc. Environmental factors impact on mosquito species diversity. India rank fifth in terms of mosquito biodiversity after Brazil, Indonesia, Malaysia and Thailand.

Key words: Mosquito, Species diversity, *Aedes*, *Culex*, *Anopheles*, *Armigeres*, Epidemics

## I.INTRODUCTION

Mosquitoes (Diptera: *Culicidae*) transmit some medically and veterinary important pathogens and parasites to humans and animals worldwide. About 750,000 deaths occur from mosquito-borne diseases annually and so they are the deadliest arthropods in the world [28],[32]. Diversity and abundance of mosquito increase in suitable environmental conditions, and so favourable conditions, enhanced mosquito-borne diseases [6]. Mosquitoes transfer diseases to about 700 million peoples annually. India is one of the countries where incidence of mosquito borne diseases are more Mosquitoes belongs to the orders Diptera in the family *Culicidae*. Only female mosquito can cause Chikungunya, yellow fever, Filariasis, Japanese encephalitis and other serious diseases to human and livestock (service, 1996) in which at least two million people dies every year. Study of mosquito diversity and

abundance is essential for management and controls of mosquitoes. In public health, the term “vectors” in broad spectrum refers to any organisms which can communicate infectious diseases to mankind and other living organisms. Major vectors belong to insects of the phylum *Arthropoda* in animal kingdom. Some important vectors are mosquitoes, sand flies, ticks, simulium, triatomine bug, etc., which transmit diseases by means of the infected bites. Weather affects the abundance, habitat suitability and distribution of the vector population [13]. Besides, it affects the reproduction rates, survival of the vectors, disease spreading capacity, feeding and biting rates. In addition, it also affects the multiplication and survival of the disease-causing pathogens which infests inside the vector. Globally, vectors are responsible for 17% of infections of mankind. More than 3.9 billion in 128 countries are prone to dengue infection with about 96 million dengue cases reported every year. As per latest report from [51] nearly 0.5 million of severe dengue cases every year. Malaria is one of the major dreadful vector-borne diseases which can cause substantial economic and social disruption. Every year nearly 4,00,000 deaths were recorded due to malaria. Malaria affects mostly children below 5 years of age [50]. In addition to the above, other illnesses like *American trypanosomiasis*, *kalaazar* and *schistosomiasis* affect the people worldwide. The burden of these vector borne diseases (VBDs) is highest in tropical and sub-tropical regions due to poor socioeconomic conditions. Most of these vectors are insects that suck blood from the host (animal or human). Vectors ingest the pathogen that causes disease while feeding on the blood of a diseased person and later transmit it to others. Due to the lack of effective vaccines or specific pharmacological drugs for most of these diseases particularly dengue fever and West Nile virus, vector management is the primary key element for the eradication of vector-borne diseases [15]. There are four methods to control vectors which include environmental control, chemical control, biological control, and personal protection measures. Biological control is a powerful strategy to reduce public health problems related to vector-borne diseases without affecting the environment [12]. In other words, biological control is an environment-friendly preventive technique to control pest organisms.

## II. DIVERSITY OF MOSQUITO IN INDIA

About 550 species of *Culex* (Linnaeus, 1778) have been described and most of them are from tropical and subtropical region. [7] reported *Culex* genus is medically important since several species act as vectors of lethal disease like lymphatic filariasis, west Nile virus, Japanese encephalitis and avian malaria. [9] reported to the 9 species in Nasik area such as *Anopheles minimus*, *Anopheles annularis*, *Anopheles sondaicus*, *Anopheles subpictus*, *Anopheles philippinensis*, *Anopheles vagus*, *Anopheles culicifaciens*, *Anopheles pallidus*, *Anopheles theobaldi*. [30] the present study 8 species are identified. Such as *Anopheles theobaldi*, *Anopheles culicifaciens*, *A.pallidus*, *A.vaguss*, *A.minimus*, *A.subpictus*, *A.sondaicus*, *A.phelipinensis*. [19] studied Diversity of mosquito Jalna urban species *Anopheles* 64%, *Culex* 11.61%, *Aedes* 19.61%, *Monsonia* 4.05%. Mosquito vector states in Nagpur city studied by [38] present study note mosquito diversity (H) winter 2.472 was significantly high than rainy season 2.398 indicated importance of abiotic factors. Ecology of mosquitoes from Kolhapur district [39] reported 22 species of mosquitoes belong to the genera *Anopheles*, *Culex* and *Aedes* which are potential vectors malaria chikungunya, dengue, chikungunya, Japanese encephalitis and filariasis. [41] studied diversity of mosquito they reported 7 species of mosquito belong to genera *Anopheles*, *Aedes* and *culex* are reported. [29] reported 45 species belonging to 3 genera *Anopheles*, *Culex*, and *Aedes* from Garwal (Uttaranchal state). [22]

studied with surveillance of *Aedes aegypti* mosquitoes in Mumbai international seaport to monitor potential global health risks they studied *Aedes* mosquitoes are highly invasive and can survive almost any climate condition. [34] reported 6 genera and 23 species in Tamilnadu dominant species in this area *Culex mimulus*, *Culex quinquefasciatus*, *Culex vishnui*, *Culex khazani*, *Culex uniformis*, *Heizmania chandi*, *Heizmannia grenii*, *Heizmannia indica*, *Oclerotatus anureostriatus*, *Oclerotatus albotaeniatis* etc. [42] carried survey of mosquito vector abundance in tribal residential area. They report 8 species of mosquitoes such as *Aedes aegypti*, *Aedes vittatus*, *Aedes albopictus*, *Culex quinquefasciatus*, *Anopheles subpictus*, *Culex gelidus*, *Culex nilgricus*, *Culex tritaeniorhynchus*. [21] reported ecological study on mosquito vectors of Japanese encephalitis virus in bellary district state Karnataka. They collected 120113 mosquitoes collected at dusk belonged to 5 genera 24 species including 13 species and also reported *Culex tritaeniorhynchus* appears to have a major role in the transmission of JE virus district Bellari. [20] studied in Guwahati mosquito vector survey carried out. They reported 7 mosquito species belong to four genera *Anopheles*, *Aedes*, *Mansonia*, and *Culex*. [27] studied the mosquito populations from Coimbatore Tamilnadu during study 13 species recorded. They reported the 13 mosquito diversity species this present *Culex quinquefasciatus* predominant species in north Coimbatore. [5] studied prevalence of vector mosquitoes of major mosquito borne disease in Indira Sagar projection Madhya Pradesh. [46] studied population dynamics of mosquito in urban and rural areas of Gwalior district, Madhya Pradesh, India. They collected 2658 mosquitoes collected that belong to 4 genera and 9 species such as *Aedes albopictus*, *Aedes aegypti*, *Anopheles stephensi*, *Anopheles annularis*, *Anopheles subpictus*, *Culex quinquefasciatus*, *Culex vishnui*, *Culex tritaeniorhynchus*, *Armigeres subalbatus*. [2] studied mosquito diversity in Sattur Taluk, Tamil Nadu, India. They identified twelve species belong to four genera. Species are *Aedes aegypti*, *Aedes albopictus*, *Aedes scatophagoides*, *Anopheles barbirostris*, *Anopheles pallidus*, *Anopheles peditaeniatus*, *Anopheles stephensi*, *Anopheles liston*, *Anopheles vagus*, *Armigeres subalbatus*, *Culex tritaeniorhynchus*, *Culex quinquefasciatus*, *Culex vishnui*. [8] two *Armigeres* species of Manipur, the easternmost northeast India. They studied general features of the *Armigeres* of the two species from two external of Manipur and Moreh Hill. [1] studied mosquito diversity in Ernakulam district of the Kerala state, south India. They identified 26 species of mosquitoes belonging to 6 genera such as *Anopheles*, *Culex*, *Aedes*, *Mansonia*, *Armigeres* and *Toxorhynchites*. Species are identified *Aedes aegypti*, *Aedes albopictus*, *Aedes pipersalatus*, *Aedes vexans*, *Aedes vittatus*, *Anopheles barbirostris*, *Anopheles gigas*, *Anopheles jamesii*, *Anopheles karwari*, *Anopheles kochi*, *Anopheles nigerrimus*, *Anopheles sinensis*, *Anopheles stephensi*, *Anopheles subpictus*, *Anopheles tessellates*, *Anopheles vagus*, *Armigeres subalbatus*, *Culex bitaeniorhynchus*, *Culex fuscocephala*, *Culex gelidus*, *Culex quinquefasciatus*, *Culex sitiens*, *Culex tritaeniorhynchus*, *Mansonia annulifera*, *Mansonia uniformis*, *Toxorhynchites splendens*. [40] studied mosquito fauna diversity in Uttar Pradesh state in India. They identify 4 species of mosquito vector belonging to 3 genera such as *Aedes*, *Anopheles* and *Culex*. *Culex quinquefasciatus* was the dominant genus followed by *Anopheles stephensi*, *Aedes albopictus* and *Aedes aegypti* while *Culex quinquefasciatus* was found throughout the year.

### III. TABLE SHOWING DISTRIBUTION OF DIFFERENT MOSQUITO IN INDIA

Sr. No	Genus	Species	Location	State	Reference
1	<i>Anopheles</i> <i>Culex</i> <i>Aedes</i>		Kolhapur	Maharashtra	[39]
2	<i>Anopheles</i> <i>Culex</i> <i>Aedes</i>		Garwal	Uttaranchal states	[29]
3	<i>Anopheles</i>  <i>Culex</i>  <i>Mansonia</i>	<i>Anopheles subpictus</i> <i>Anopheles peditaeniatus</i> <i>Anopheles barbirostris</i> <i>Culex tritaeniorhynchus</i> <i>Culex quinquefasciatus</i> <i>Culex psedovishnui</i> <i>Culex vishnui</i> <i>Culex gelidus</i> <i>Culex fuscocephala</i> <i>Culex bitaeniorhynchus</i> <i>Mansoni annulifera</i> <i>Mansoni uniformis</i>	Bellary district	Karnataka	[21]
4	<i>Culex</i>  <i>Armigeres</i>	<i>Culex quinquefasciatus</i> <i>Culex Pseudovishnu</i> <i>Culex gelidus</i> <i>Armigeres subalbatus</i>	Coimbatore	Tamil Nadu	[27]
5	<i>Anopheles</i> <i>Aedes</i> <i>Culex</i> <i>Mansonia</i>		Jalna	Maharashtra	[19]

6	<i>Anopheles</i> <i>Culex</i> <i>Aedes</i>	<i>Anopheles stephensi</i> <i>Culex quinquefasciatus</i> <i>Aedes aegypti</i> <i>Aedes albopictus</i>	Lucknow (Neelmatha, Vrindavan colony)	Uttar Pradesh	[40]
7	<i>Anopheles</i>    <i>Culex</i> <i>Aedes</i>	<i>Anopheles culicifacies</i> <i>Anopheles stephensi</i> <i>Anopheles annularis</i> <i>Anopheles fluviatilis</i> <i>Culex quinquefasciatus</i> <i>Aedes aegypti</i>	Akola and Talhora region	Maharashtra	[41]
8	<i>Anopheles</i> <i>Culex</i>  <i>Aedes</i>	<i>Anopheles minimus</i> <i>Culex quinquefasciatus</i> <i>Culex tritaeniorhynchus</i> <i>Aedes aegypti</i> <i>Aedes albopictus</i>	Guwahati	Assam	[20]
9	<i>Anopheles</i> <i>Culex</i>  <i>Aedes</i>	<i>Anopheles subpictus</i> <i>Culex quinquefasciatus</i> <i>Culex gelidus</i> <i>Culex nilgricus</i> <i>Culex tritaeniorhynchus</i> <i>Aedes aegypti</i> <i>Aedes vittatus</i> <i>Aedes albopictus</i>	Sitheri and selur villages	Tamil Nadu	[42]
10	<i>Anopheles</i>  <i>Culex</i>  <i>Aedes</i>	<i>Anopheles stephensi</i> <i>Anopheles fluviatilis</i> <i>Culex quinquefasciatus</i> <i>Culex vishnui</i> <i>Aedes aegypti</i>	Indira Sagar projection (MP)	Madhya Pradesh	[5]
11	<i>Anopheles</i>	<i>Anopheles subpictus</i> <i>Anopheles stephensi</i> <i>Anopheles culiciformis</i> <i>Anopheles maculates</i>	Puducherry	Tamil Nadu	[34]

	<i>Culex</i>	<i>Culex quinquefasciatus</i> <i>Culex pseudovishnui</i> <i>Culex tritaeniorhynchus</i> <i>Culex decens</i>			
	<i>Aedes</i>	<i>Aedes aegypti</i> <i>Aedes albopictus</i> <i>Aedes stokes</i> <i>Aedes simpsoni</i>			
12	<i>Anopheles</i>	<i>Anopheles subpictus</i> <i>Anopheles culicifacies</i> <i>Anopheles annularis</i> <i>Anopheles barbirostris</i> <i>Anopheles hyrcanus</i> <i>Anopheles gigas</i> <i>Anopheles jamsei</i>	Nagpur	Maharashtra	[38]
	<i>Culex</i>	<i>Culex quinquefasciatus</i> <i>Culex gelidus</i> <i>Culex vishnui</i> <i>Culex tritaeniorhynchus</i> <i>Culex pseudovishnui</i>			
	<i>Aedes</i>	<i>Aedes aegypti</i> <i>Aedes albopictus</i> <i>Aedes vitatus</i>			
	<i>Armigeres</i>	<i>Armigeres subalbatus</i> <i>Armigeres abturbans</i> <i>Mansonia uniformis</i>			

13	<i>Culex</i>  <i>Heizmania</i>  <i>Oclerotatus</i>	<i>Culex mimulus</i> , <i>Culex quinquefasciatus</i> , <i>Culex vishnui</i> , <i>Culex mimulus</i> , <i>Culex khazani</i> , <i>Culex uniformis</i> , <i>Heizmania chandi</i> <i>Heizmannia grenii</i> , <i>Heizmannia..indica</i> <i>Oclerotatus anureostriatus</i> <i>Oclerotatus alboteniatis</i>	Western ghat	Tamil Nadu	[34]
14	<i>Anopheles</i>  <i>Culex</i>  <i>Aedes</i>  <i>Armigeres</i>	<i>Anopheles barbirostris</i> , <i>Anopheles pallidus</i> , <i>Anopheles peditaeniatus</i> , <i>Anopheles stephensi liston</i> , <i>Anopheles vagus</i> , <i>Culex tritaeniorhynchus</i> , <i>Culex quinquefasciatus</i> , <i>Culex vishnui</i> <i>Aedes aegypti</i> , <i>Aedes albopictus</i> , <i>Aedes scatophagoides</i> <i>Armigeres subalbatu</i>	Sattur talak	Tamil Nadu	[2]
15	<i>Anopheles</i>  <i>Culex</i>  <i>Aedes</i>  <i>Armigeres</i>	<i>Anopheles stephensi</i> , <i>Anopheles annularis</i> , <i>Anopheles subpictus</i> <i>Culex quinquefasciatus</i> , <i>Culex vishnui</i> , <i>Culex tritanaerhyncus</i> <i>Aedes albopictus</i> , <i>Aedes aegypti</i> , <i>Armigeres subalbatu</i>	Gwalior District.	Madhya Pradesh	[46]
16	<i>Armigeres</i>	<i>Armigeres obturbans</i> <i>Armigeres aureolineatus</i>	Northeast India	Manipur	[8]





19	<i>Aedes</i>	<i>Aedes aegypti</i>	Mumbai	Maharashtra	[22]
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#### IV. VECTOR BORNE DISEASES IN HUMAN

MOSQUITO	VECTOR	PATHOGEN	DISEASE	REFRENCE
<i>Aedes</i>	<i>Aedes egypti</i> <i>Aedes albopitus</i>	Dengue virus	Dengue Fever	[14],[25]
<i>Anopheles</i>	<i>Anopheles stephensi</i> <i>Anopheles darlingi</i> <i>Anopheles gambiae s..l</i>	Plasmodium vivax Plasmodium Falciparum	Malaria	[3],[4],[44]
<i>Aedes</i>	<i>Aedes egypti</i>	Y V virus	Yellow fever	[36],[17], [45]
<i>Culex</i>	<i>Culex quiquifasciatus</i>	Wuchereria bancfroti	Filariasis	[11]
<i>Aedes</i>	<i>Aedes egypti</i> <i>Aedes albopitus</i>	Chikungunya virus	Chikungunya	[31],[14]
<i>Culex</i>	<i>Culex quiquifasciatus</i> <i>Culex tarsalis</i> <i>Culex pipiens</i> <i>Aedes egypti</i>	West Nile virus	West Nile Fever	[25],[48], [49]
<i>Aedes</i> <i>Culex</i>		Rift Valley Fever virus	Rift Valley Fever	[35],[23]
<i>Aedes</i>	<i>Aedes egypti</i> <i>Aedes albopitus</i>	Zika virus	Zika	[18],[47]
<i>Culex</i>	<i>Culex tritaeniorhynchus</i> <i>Culex vishnui</i> <i>Culex pseudovishnui</i>	Japaness encephalitis virus	Japanese encephalitis	[25],[10], [16]

## V. VECTOR BORNE DISEASES IN VETERINARY

MOSQUITO	VECTOR	PATHOGEN	DISEASES	HOST	REFERENCE
<i>Anopheles</i>	<i>Anopheles moucheti</i>	<i>P. adleri</i> , <i>P. blacklocki</i> , <i>P. praefalciparum</i> , <i>P. reichnetii</i>	Primate malaria	Great apes such as gorillas, chimpanzees	[24],[37]
<i>Culex</i> <i>Mansonia</i> <i>Coquillettidia</i>	<i>Culex spp.</i> , <i>Mansonia spp.</i> , <i>Coquillettidia spp.</i>	<i>Plasmodium spp.</i> , <i>Haemoproteus spp.</i>	Avian malaria	Birds	[43],[33]
<i>Aedes</i>	<i>Aedes albopictus</i> , <i>Aedes aegypti</i>	<i>Dengue virus</i>	Dengue fever	Squirrels, monkeys	[14],[25],[31]
<i>Aedes</i>	<i>Aedes albopictus</i> , <i>Aedes aegypti</i>	<i>Chikungunya virus</i>	Chikungunya	Mammals, Birds	[14]
<i>Aedes</i>	<i>Aedes albopictus</i> , <i>Aedes aegypti</i>	<i>Yellow fever virus</i>	Yellow fever	Mammals, Birds, Primates	[17],[45]
<i>Aedes</i>	<i>Aedes albopictus</i> , <i>Aedes aegypti</i>	<i>Zika virus</i>	Zika	Migrant birds, Calao, Pigeons, Mammals, Monkey, Apes	[18],[47]
<i>Aedes</i> <i>Culex</i>	<i>Aedes spp.</i> <i>Culex spp.</i>	<i>Rift Valley fever virus</i>	Rift Valley	Goats, Sheep, Cattle, Gazelles, Buffalo, Camels	[35],[23]

## VI. CONCLUSION

The current study provides information about the diversity of *Culicidae* in India. Total 651 specimens, belonging to 13 species and 4 genera have been recorded in the present day. The presence of various vector species of dengue, chikungunya, malaria, Japanese encephalitis and filariasis in the district suggests that vector surveillance strategies should be performed to prevent vector-borne diseases in different district. The current study was carried

out for a short period and in selected areas therefore recommend further studies to be carried out to uncover a detailed checklist of mosquito composition.

## VII. ACKNOWLEDGEMENTS

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