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Mosquito biodiversity of Dibru-Saikhowa biosphere reserve in Assam, India

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Abstract: *Entomological surveys were conducted for three consecutive years in core and buffer zone of the Dibru-Saikhowa biosphere reserve in pre monsoon, monsoon and post-monsoon seasons. A total of 52 species of mosquitoes under eleven genera have been detected. The genus Anopheles (18 species) was the predominant followed by Culex, Aedes, Mansonia, Armigeres, Mimomyia, Ochlerostatus, Malaya, Toxorhynchites, Ficalbia and Aedeomyia. The buffer zone of the forest reserve where human habitations are there exhibited the presence of maximum number of species (49 species under 10 genera) in comparison to core zone (42 species under 10 genera). In buffer zone, maximum numbers of species (38) were recorded in monsoon season followed by post- monsoon (35 species) and Pre-monsoon season (34 species). Whereas in core zone, maximum number of species were collected in post monsoon season followed by pre monsoon season and monsoon season. In Core and buffer zone, the maximum species were recorded from the ground pool habitat and slow flowing stream respectively. Among the disease vectors, the potential Japanese encephalitis vectors incriminated in India were very much prevalent. This study provides the list of available mosquito species recorded for the first time in the Dibru-Saikhowa biosphere reserve.*

Key words: *Mosquito, Biodervisity, Dibru-Saikhowa biosphere reserve, Japanese encephalitis*
PDF of full length paper is available online

Introduction

Mosquitoes are the most important among other arthropod vectors of human disease in the tropic and are notoriously responsible for causing much greater misery to mankind than all other combined together (Tandon, 1998). Mosquitoes are dipterous flies belonging to the family Culicidae and are currently the most extensively studied group of haematophagus insects. The role of mosquitoes in the health and well being of man is both direct and indirect. Mosquitoes act as vector of protozoan, helminth and viral agents. Besides they cause discomfort, annoyance and blood loss to the host.

Most of the mosquito faunistic studies in India (Dhanpal and Naik, 1986; Nagpal and Sharma, 1987; Khame and Khaliwal, 1988) have been done in relation to the geographic location. These studies provide information on the distribution of mosquito species in different regions or states (Rajavel *et al*., 2001). Mosquito species present in various places of North East India were studied morphologically and ecologically by numerous investigators and workers (Challam, 1923; Strickland, 1929; Vishanathan, 1941; Kareem *et al.*, 1983; Nagpal and Sharma, 1987; Malhotra and Mahanta, 1994; Rajput and Singh, 1988;).The Regional Medical Research Centre, (ICMR) has also conducted several mosquito surveys and studied vector bionomics in the region (Dutta *et al*., 1992,1993,1996,1999; Prakash *et al*., 1997,1998 a,b,c; Khan *et al*.,1998).

The monograph on Indian *Anophiline* and *Culicine* published by Christopher (1933) and Barraud (1934) is the only documents with coverage of the mosquitoes in some parts of Assam. Comprehensive recent information on distribution of mosquito species in N.E. Region of India is very meager (Dutta *et al.,* 1996). The documents published by captain P.J. Barraud and Sir Richard Christopher way back in 1934 and 1933 respectively have now become out dated. It was noted earlier that of the 239 described Indian *Culicine* mosquitoes, larvae of 96 species were unknown and many additional species awaited discovery (Barraud, 1934). Dibru-Saikhuwa biosphere reserve which is situated about 70 km. away from Dibrugarh has been selected to carryout a mosquito faunistic and ecotaxonomical study. It is not only a biosphere reserve but also a National Park where species diversity may be interesting. It is also noted that no study on mosquitoes has been done in this biosphere reserve area. A proper study on mosquito fauna in this biosphere reserve will help finding the distribution pattern of different mosquito species including the disease vectors in different seasons as well as in different ecological conditions. It will also provide a database of the mosquitoes of this biosphere reserve area.

Materials and Methods

Study area: Dibru-Saikhowa biosphere reserve is an evergreen rainforest of Upper Assam, located in between 27.3°' N. to 27°45' N latitude and 95°10'E to 95° 45' East longitudes and with an average altitude of 118 m above the mean sea level. The total area of the forest is 765 sq. km. The reserve forest is situated on Brahmaputra valley, which is in between the south bank of the river Brahmaputra and North bank of the Dibru River. The forest is located in the north of Tinsukia District and in the eastern part of Dibrugarh District. The Biosphere reserve consists of three distinct zones viz, core zone, buffer zone and the transition zone (Fig. 1).

Dibru-Saikhowa enjoys a tropical monsoon climate with a hot and wet summer and a cool and dry winter. The annual rainfall ranges from 2300 to 3800 mm. The main rainy months are June,

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July, August, and September. The annual temperature of the area ranges from 7 to 34°C where June, July and August are the hottest while December and January are the coolest months. Dibru-Saikhowa is a deciduous littoral and swamp forest and patches of wet-evergreen forest. The forest is having about 35.84% moist mixed forest, 9.50% degraded forest and 21.25% grassland.

Core zone: The core zone is kept absolutely undisturbed. It must contain suitable habitat for numerous plant and animal species, including higher orders predators and may contain centers of endemism. Core areas often conserve the wild relatives of economic species and may also present important genetic reservoirs.

In Dibru-Saikhowa biosphere reserve, the core zone is covering an area of 340 sq. km. and is situated in the South bank of the river Brahmaputra and North bank of the Dibru river.

Buffer zone: Surrounding the core zone, the buffer zone protects the core zone. The zone is occupying an area of 425 sq. km. with 41 fringe villages. Topographically, this zone is highly vibrating with deep canals, pools and grasslands.

All types of possible breeding habitats found in the reserve area were searched and immatures were collected with WHO recommended Dippers or large spoons and information like breeding habitat, collection timing, place, season etc. were noted. Immatures collected were transported to the RMRC laboratory and were individually reared to get the mature one. The larval, pupal skeins were mounted along with the preservation of the adult specimen. The collected specimens were identified by following the standard mosquito identification keys and nomenclature (Barraud, 1934; Christopher, 1933; Knight and Stone, 1977; Puri, 1954; Rao, 1984; Das *et al.*, 1990; Reuben, 1985,1994; Wattal and Kalra, 1951; Ward Ronald, 1992; Reinert, 2001)

The adult mosquitoes were collected by suction tubes and by operating CDC miniature light traps from the forest camps and from cattle sheds or human-dwellings in buffer zone (where human habitation is there). The collected mosquitoes were transported in Barraud cages or test tubes to RMRC laboratory for proper identification.

The occurrence of mosquito species in relation to ecological conditions of core zone and buffer zone of the biosphere reserve were recorded and the variations in species if any were studied. The processing of collected materials and all other entomological works were done in the entomological laboratory at RMRC (ICMR), Dibrugarh, Assam.

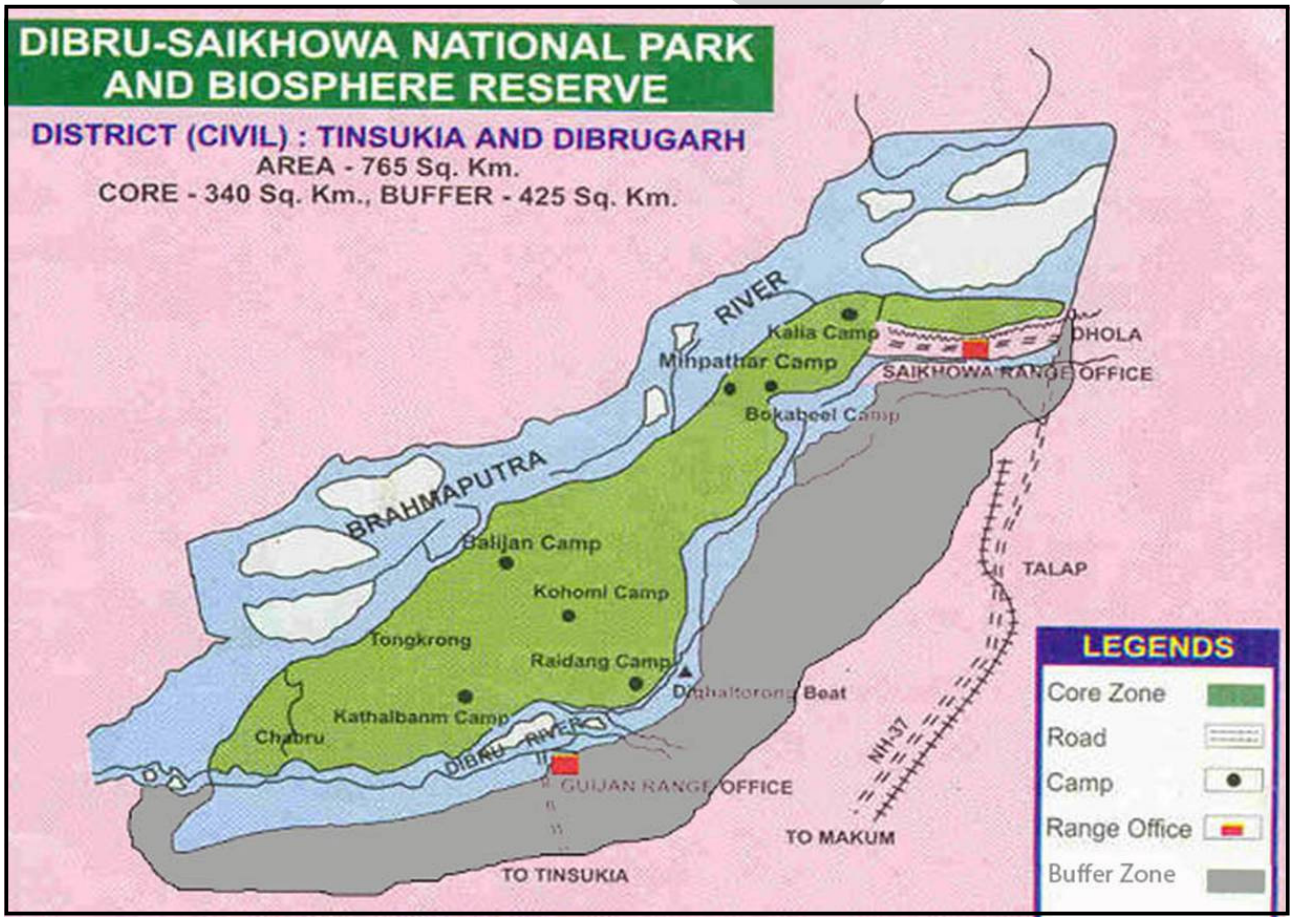

Fig. 1: Dibru-Saikhowa biosphere reserve consists of three Distinct zones *viz.*, Core zone, Buffer zone and the Transition zone

Table - 1: Zone wise record of species (from both core and buffer zones) during three years study period

S.No.	Species	Core zone			Buffer zone		
		2002	2003	2004	2002	2003	2004
1	*Ad. (Ady.) catasticta*	+	-	-	-	-	-
2	*Ae. (Aed.) vaxans*	+	+	+	+	+	+
3	*Ae.(Adm.) nigrostriatus*	-	-	-	-	+	+
4	*Ae. (Dic.) iyengari*	+	-	-	-	-	-
5	*Ae. (Neo.) lineatopennis*	-	-	-	+	+	-
6	*Ae. (Stg.) albopictus*	+	+	+	+	+	+
7	*Ae. (Stg.) annandalai*	-	-	-	-	+	+
8	*An. (Ano.) ahomi*	+	-	-	-	-	-
9	*An. (Ano.) barbirostris*	+	+	+	+	+	+
10	*An. (Ano.) crowfordi*	-	-	+	-	-	+
11	*An. (Ano.) gigas*	+	+	+	+	+	+
12	*An. (Ano.) hyrcanus*	+	+	+	+	+	+
13	*An. (Ano.) nigerrimus*	+	-	+	+	-	+
14	*An. (Ano.) peditaeniatus*	-	+	+	+	+	+
15	*An. (Ano.) sinensis*	-	-	+	+	+	-
16	*An. (Cel.) annularis*	+	+	+	+	+	+
17	*An. (Cel.) culicifacies*	-	-	+	-	-	+
18	*An. (Cel.) karwari*	-	+	-	-	+	-
19	*An. (Cel.) kochi*	-	+	+	+	+	+
20	*An. (Cel.) maculatus*	+	+	+	+	+	+
21	*An. (Cel.) nivipes*	-	+	-	+	-	-
22	*An. (Cel.) philippinensis*	-	+	-	+	+	-
23	*An. (Cel.) tessellatus*	-	+	-	-	+	-
24	*An. (Cel.) vagus*	+	+	+	+	+	+
25	*An. (Cel.) willmorei*	-	-	+	-	+	+
26	*Ar .(Arm.) durhami*	-	-	-	-	+	+
27	*Ar .(Arm.) kuchingensis*	-	+	+	+	+	+
28	*Ar .(Arm.) subalbatus*	-	+	+	+	+	+
29	*Cx .(Cux.) bitaeniorhynchus*	+	+	+	+	+	+
30	*Cx .(Cux.) fuscocephala*	+	+	+	+	+	+
31	*Cx .(Cux.) gelidus*	+	+	+	+	+	+
32	*Cx .(Cux.) infula (domesticus)*	-	-	-	-	+	-
33	*Cx .(Cux.) mimeticus*	+	+	-	-	+	-
34	*Cx .(Cux.) pseudovishnui*	+	+	+	+	+	+
35	*Cx .(Cux.) quinquefasciatus*	-	+	+	+	+	+
36	*Cx .(Cux.) tritaeniorhynchus*	+	+	+	+	+	+
37	*Cx .(Cux.) vishnui*	+	+	+	+	+	+
38	*Cx .(Cux.) whitmorei*	-	-	+	-	+	+
39	*Cx .(Eum.) malayi*	-	+	+	-	+	+
40	*Cx .(Lut.) fuscanus*	+	+	+	+	+	+
41	*Cx .(Lut.) halifaxi*	-	-	+	-	-	+
42	*Fi .minima*	-	-	+	-	-	+
43	*Ma. (Mnd.) annulifera*	-	-	-	+	+	+
44	*Ma. (Mnd.) dives*	-	-	-	+	+	+
45	*Ma. (Mnd.) indiana*	-	-	-	+	-	-
46	*Ma. (Mnd.) uniformis*	-	-	+	+	+	+
47	*Mi .(Eto.) luzonensis*	-	+	-	-	+	-
48	*Mi .(Mim.) chamberlaini*	+	-	-	-	+	-
49	*Ml .(Mao.) genurostris*	-	-	+	-	+	+
50	*Oc. (Fin.) pallirostris*	-	-	+	-	+	+
51	*Oc. (Muc.) scatophagoides.*	-	-	-	-	+	-
52	*Tx .(Tox.) splendens*	-	-	-	-	+	+
	Total species	**21**	**27**	**32**	**29**	**42**	**37**
			42			**49**	

+ = Present, - = Absent

Results and Discussion

Entomological surveys have been conducted around the camps with the help of the forest guards to enter into the forests for collection of mosquito larvae from different aquatic habitats prevailing in the forests. During three years study period consecutively from the year 2002 to 2004, a total of 52 species of mosquitoes under eleven genera have been detected. The genus *Anopheles* found to be the predominant comprising of 18 species followed by *Culex*-13 species, *Aedes*-6 species, *Mansonia*- 4 species, *Armigeres*- 3 species, *Mimomyia*- 2 species, *Ochlerostatus*- 2, Malaya- 1 species, *Toxorhynchites*- 1 species, *Ficalbia*- 1 species and *Aedeomyia*- 1 species.

The findings of mosquito collected revealed that the buffer zone of the forest reserve where human habitations are there exhibited the presence of maximum species (49 species under 10 genera) in comparison to the core zone where 42 species under 10 genera were recorded. In year wise collection at core zone, it was observed that 21 species under 5 genera in first year (2002), 27 species under 5 genera in 2nd year (2003) and 32 species under 8 genera in 3rd year (2004) were encountered. Similarly, in buffer zone of the biosphere reserve, the highest species composition (42 species under 9 genera) was found in the year 2003 followed by 38 species under 8 genera during 2004 and 34 species under 7 genera in 2002 (Table 1).

The seasonal prevalence of mosquito species in core and buffer zone are shown in Fig. 2. The occurrence of number of mosquito species in buffer zone was higher than that of core zone. In buffer zone season wise occurrence revealed that maximum species (38) was recorded in monsoon season followed by post- monsoon season with 35 species and pre-monsoon season with 34 species. Whereas in core zone, the number of species recorded was higher in post monsoon season followed by pre monsoon season with 28 species and monsoon season with 28 species. The reason for detection of less number of mosquito species during monsoon season in core zone was due to flood situation inside the biosphere reserve which washed out maximum breeding habitats of mosquitoes. After receding of floodwater only the breeding of mosquitoes were observed and therefore, post monsoon season exhibited breeding of more number of species in core zone. In contrast to core zone, the buffer zone exhibited more species breeding during monsoon season because buffer zone is of high land with no flood situation; therefore during rainy season only the breeding of mosquitoes becomes prominent in this zone.

Aedeomyia catasticta, Aedes iyengari and *Anopheles ahomi* were detected only from the core zone. Some of the species, which were collected only from the buffer zone, were *Aedes nigrostriatus, Aedes lineatopennis, Armigeres durhami, Culex infula var. domesticus, Mansonia annulifera, Mansonia dives, Mansonia Indiana, Ochlerostatus scatophagoides* and *Toxorhynchites splendens*. Habitat-wise species diversity in core zone and buffer zone of Dibru-Saikhowa biosphere reserve is shown in Fig. 3 and 4 respectively. In core zone, the maximum species was recorded from the ground pool habitat followed by slow flowing stream, stream pool and colocasia/pine apple leaf axils, ditch/banana stump/swamp, stream margin, channel, sandy pool, bheel, river detached pool, banana leaf axil, fallen big leaf area, fallow field.

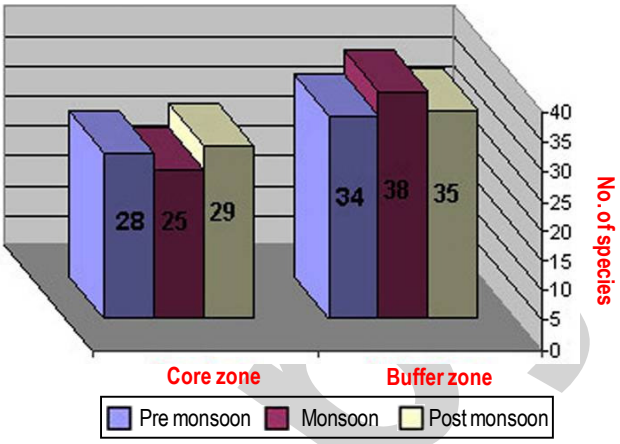

Fig. 2: Seasonal prevalence of mosquito species in core and buffer zones of Dibru-Saikhowa biosphere reserve

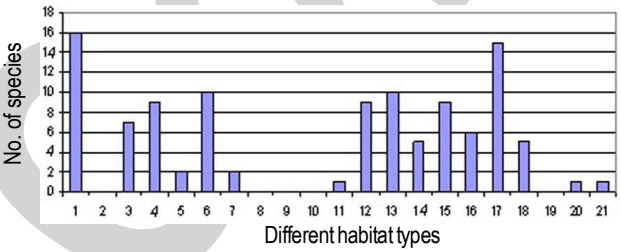

Fig. 3: Species diversity in different Habitat found in core zone of Dibru-Saikhowa biosphere reserve

1 = ground pool, 2 = drain beside paddy field, 3 = stream margin, 4 = ditch, 5 = bheel, 6 = stream pool, 7 = river detached pool, 8 = flood pool, 9 = pond, 10 = bamboo stump, 11 = banana leaf axil, 12 = banana stump, 13 = colocasia and pineapple leaf axil, 14 = tree hole, 15 = swamp, 16 = channel, 17 = slow flowing stream, 18 = sandy pool, 19 = river, 20 = big leaf area, 21 = Fallow field

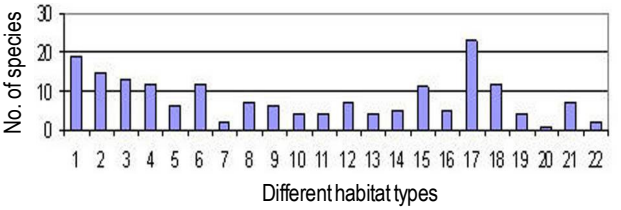

Fig. 4: Species diversity in different Habitat found in buffer zone of Dibru-Saikhowa biosphere reserve

1 = ground pool, 2 = drain beside paddy field, 3 = stream margin, 4 = ditch, 5 = bheel, 6 = stream pool, 7 = river detached pool, 8 = flood pool, 9 = pond, 10 = bamboo stump, 11 = banana leaf axil, 12 = banana stump, 13 = colocasia and pineapple leaf axil, 14 = tyre, 15 = swamp, 16 = channel, 17 = slow flowing stream, 18 = sandy pool, 19 = tree hole, 20 = Artificial container, 21 = Fallow field, 22 = tree stump-hole of dead tree.

In buffer zone, from the breeding habitats as shown in Fig. 4, the maximum breeding was detected from the habitat of slow flowing stream followed by ground pool, drain beside paddy field, stream margin, ditch/sandy pool, flood pool/fallow field/banana stump, pond, tyre/channel, bamboo stump/banana leaf axil/colocasia leaf axil, tree stump hole of dead tree, artificial container. Among the disease vectors, the potential Japanese encephalitis vectors viz, *Culex (Cux.) bitaeniorhynchus*,*Cx. (Cux.) fuscocephala*, ,*Cx. (Cux.) gelidus, Cx.(Cux,) tritaeniorhynchus, Cx.(Cux,) vishnui, Cx.(Cux,) pseudovishnui, Culex (Cux.) whitmorei, Mansonia (Man.) annulifera*, *Ma. (Man.) dives, Ma. (Man.) Indiana, Ma. (Man.) uniformis, Anopheles (Ano.) barbirostris, An.(Ano.) 'hyrcanus' group* as reported from India (Rodrigues, 1984) are very much prevalent in this biosphere reserve. There are so many wet lands inside this biosphere reserve (Fig. 2) and therefore it is a beautiful place for migratory birds including ardeid birds which may play as reservoir for JE virus in natural cycle. As no study on mosquitoes was carried out in this biosphere reserve area earlier, this is only maiden report of mosquitoes recorded in the Dibru-Saikhowa biosphere reserve.

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