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DIVERSITY OF ANOPHELES SPECIES IN ERODE DISTRICT

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ABSTRACT

Insects are the only invertebrates to have evolved flight. Insects are the most diverse groups of animals on the planet. The Diptera are the most diverse. They have an immense potentiality for rapid increase and are known to spread diseases such as malaria, yellow fever and dengue.The genera Anopheles is dangerous because it transmits malaria. The total number of global cases of vector borne diseases every year is approximately 1 billion. In the present study totally six species of Anopheles mosquitos were collected from different larval habitats including agro ecosystem.

KEYWORDS: Diptera, Dengue.

INTRODUCTION

Insects are the only invertebrates to have evolved flight. Insects are the most diverse groups of animals on the planet, including more than a million described species and representing more than half of all known living organisms (Chapman, 2006; Wilson, 2009). Complete metamorphosis is unique to a group of certain insect orders including Diptera.

The Diptera are the most diverse insect order and mosquitoes (Culicidae) belong to the order diptera. The vast majority of lower diptera have larvae and pupae that are aquatic or semi-aquatic (Foote, 1987; Brown, 2001; Meritte *et al.*, 2003). They have an immense potentiality for rapid increase and are known to spread diseases such as malaria, yellow fever and dengue. However, these species, which are largely confined to the Genera *Aedes*, *Anopheles*, *and Culex.* Mosquitoes are vectors of a number of agents including malaria, yellow fewer, filariasis, dengue, dog heart worm, the encephalitis and related viral diseases. Climate change parameters like temperature, rainfall, humidity and other parameters also have an impact on

mosquitoe population, diversity and diseases transmission (Reiter, 2001; Sutherst, 2004). The total number of global cases of vector borne diseases every year is approximately 1 billion. Mosquitoes are considered the deadliest animal in particular, the *Anopheles* mosquito is dangerous because it transmits Malaria. For malaria alone, a staggering 300-500 million people are infected and 1.0-1.5 million people die every year and an African child dies from malaria every 30 seconds (WHO, 2007). The frequency of mosquito transmitting diseases increases due to major ecological changes in the India. It has been reported that deforestation, industrialization, agriculture, migration of populations, new settlements, population explosion, new settlements, non-planned urbanization and unplanned garbage management in the last two decades (Malhotra and Mahanta, 1994).

However, according to the malaria report 2013, *Plasmodium vivax* develops in *Anopheles* mosquito, at wider temperature ranges. Outbreak of Japanese Encephalitis, Malaria and Dengue may be facilitated by two factors i.e., global climate change and the modulation of agricultural practices. Mosquito borne diseases currently represent greater health problems in tropical and subtropical countries. This study was carried out in Erode District, Tamil Nadu to identify the larval habitats and diversity of *Anopheles* mosquito which is the major vector for malaria.

MATERIALS AND METHODS

Erode District is extended between 10-35' and 11-60' of north latitude and 76.49' and 77.58' of East longitude. Urban, rural and forest fringes were chosen for mosquito collections and random collections were also done from other areas. Oral aspirator, mechanical aspirator and sweep nets were used for adult mosquito collection. The study carried out from 2012-2013 to 2013-2014. Collection were done during Dawn and Dusk. The standard dipper 400ml (WHO, 1975) was used for the collection of the mosquito larva.

Mosquitoes were anesthetized with ethyl acetate and mounted on a minute pin under a binocular stereo microscope. Adults collected in the field were assigned the code RC (Resting Collection) and numbered on pinning as RC1, RC2, RC3, etc., with the date of collection, collection site and habitat. Larval samples were maintained separately with a code number. Larval skin of fourth-instar larvae were removed and preserved in 70% alcohol with the respective code numbers for slide mounts for identification by using Hoyer's medium (Belkin, 1962). Collected specimens were identified in Vector Control Research Centre,

Pondicherry using the works of Christophers (1933), Barraud (1934), Bram (1967), Huang (1972, 1979), Sirivanakarn (1976), Rao (1981, 1984), Reuben *et al.*, (1994).

PHYSICOCHEICAL ANALYSIS

Thermometer was used for recording temperature, pH and TDS were recorded with the help of Digital meter. The standard method "Water and Waste Water Analysis" by APHA (2005) was used for Salinity analysis.

DIVERSITY INDEX

The diversity of the collected mosquitoes were statistically assessed by using Shannon-Weiner index, Simpson's index, Pielou's Evenness, Dominance and Margalef's Index were calculated by the software PAST 3.x (version 2013).

RESULTS AND DISCUSSION

The diversity of mosquitoes in the study area shows the availability of breeding habitats, resting places and favourable climatic factors like temperature and rainfall. A total of six species *Anopheles nigerrimus, Anopheles peditaeniatus, Anopheles culicifacies, Anopheles stephensi, Anopheles subpictus and Anopheles vagus* were collected during the study period. *Anopheles* species are vectors of malaria and were collected in various natural breeding sites like paddy fields, harvested paddy fields, ground pool, river bed pool, seepage and stagnant waters. In India and its neighboring countries, the biology of Anopheline mosquitoes, particularly malaria vectors has been studied extensively (Rao, 1981). The agro-eco system favours high degree of diversity and provide ideal conditions for Anophiline mosquitoes. Continues water management in the rice fields enriched mosquito population. *An.culicifacies* larvae were collected during the first month. But *An.subpictus* larvae were found only in the second month from the rice fields. During the study period paddy field water temperature, pH, TDS and Salinity ranges between 28.6-30°C, 7.1-7.36, 273-386mg/l and 0.40-0.74ppm.

Spread of Nitrogenous fertilizers enriches mosquito larval population in rice fields (Simpson and Roger, 1991) Paddy cultivation and irrigation system provide a suitable source of breeding places of mosquitoes (Kanojia *et al.,* 2003). In South Korea, Anopheline species were found associated with flooded rice fields (Sithiprasana *et al.,* 2005). Addition of Nitrogenous fertilizers after few days after transplantation attracts *Anopheles* and Culicine mosquitoes for oviposition (Sanford *et al.,* 2005). Adults of *An.peditaeniatus* were collected near the paddy fields. Shannon index recorded for *An.peditaeniatus* was 2.23 and Richness

was 2.084. *An.culicifacies* prefers fresh water pits (Rusell and Rao, 1942). In India, *An.culicifacies* was reported from domestic well and pits used for plantation of coconuts (Rajendran *et al.,* 1986). However, in the present study *An. culicifacies* was collected from different habitats like river bed pool, ground pool, stagnant and seepage pools. Temperature of the habitats ranges between 24.75±1.70-26.45±3.10, and pH recorded was 6.9±0.08-7.06±0.12. TDS levels of breeding habitats was 154.21±53.21 - 485.23±56.73 and salinity of the habitats ranges between 0.08±0.01 - 0.79±0.09. Devi and Jauhari, (2004) reported *An.culicifacies, An.fluviatilis, An.annularis* and *Cx.quinquefasciatus* from seepage water in India. *An.culicifacies* found in this study is the major rural malarial vector in India (Khan *et al.,* 2014). Diversity indices shows Shannon's index 2.127 and richness 1.766 for *An.culicifacies* (Table 2).

An. stephensi breeds in all sources of larval breeding habitat even in water pools used for building constructions. In rural areas Manoucheri *et al.,* (1976) found this species in different water bodies' like stream beds, palm irrigation canals, margin of river beds and seepages. Malaria vector *An.stephensi* was addressed from different parts of India (Hati *et al.,* 1992; Sharma *et al.,* 1993). In the present study immatures of *An.stephensi* were collected from the river bed areas with temperature of 26.45±3.10, pH 6.9±0.10, TDS 154.21±53.21 and salinity 0.08±0.01. Likewise in Southern Iran, Hanafi – Bojd *et al.,* (2012) also reported *An.stephensi* from river with sandy bed areas. Attaullah *et al.,* (2015) recorded *An.stephensi* adults from the poultry farms in rural areas. Similarly, adults of *An.stephensi* were collected from cattle sheds and poultry farms during the period of study. Recorded Shannon's index was 2.215 and Marglef's richness was 2.078 for these species.

During the present study *An.subpictus* was reported from natural habitat river bed pool with temperature of 26.45±3.10, pH 6.9±0.10, TDS 154.21±53.21 and salinity 0.08±0.01. *An.subpictus* is a vector for human filariasis and considered as non-vector (Raghavan, 1969). Devi and Jauhari, (2004) reported this species from paddy field, seepage and streams. It is also recorded from paddy fields, ground pool, tree hole and broken pot by Chandrasekar *et al.,* (2012) in Tamil Nadu and Balasubramanian and Nikhil, (2013) in Kerala. Shannon's index 2.092 and Marglef's richness was 1.896 for *An.subpictus.* The study *An.nigerrimus* adults were collected from cattle sheds. Shannon index and Richness recorded for *An.nigerrimus* was 2.23 and 2.084. In India and Indonesia *An.nigerrimus* was recognized as a vector for human filariasis (Sathish Kumar and Vijayan, 2005). Sahu *et al.,* (2008) reported

An.vagus from cattle sheds and human dwellings. This findings were corroborated with the present work and *An.vagus* was collected from cattle sheds. Shannon index 2.142 and Richness 1.777 was recorded for *An.vagus.* In Erode, Tamil Nadu Rajeswari *et al.,* (2017) documented six mosquitoes species belonging to the genus *Anopheles* (26.27%) in different aquatic habitats and from cattle sheds. Agro-eco system and rain fall enriches the breeding habitats of *Anopheles* mosquitoes. During the rainy season number of species recorded were high than the other seasons. Rain fall produces new breeding habitats in the study area. The current results are reliable with Sahu *et al.,* (2011) who recorded highest density of *An.minimus* and *An.fluvatilius* during rainy season.

TABLE 1: MEAN VALUES OF PHYSICOCHEMICAL PARAMETERS DURING THE STUDY PERIOD.

S.No	Temperature° C	pH	TDS(mg/l)	Salinity(ppm)
Ground Pool	24.75±1.70	7.06±0.12	243.68±115.89	0.54±0.11
River Bed	26.45±3.10	6.9±0.10	154.21±53.21	0.08±0.01
Stagnant Water	25.45±2.50	7.05±0.05	485.23±56.73	0.79±0.09
Seepage Pool	25.35±2.00	6.9±0.08	349.91±93.32	0.27±0.06

TABLE 2: ALPHA DIVERSITY INDEX OF MOSQUITO SPECIES.

S.No	SPECIES	Individuals	Dominance	Simpson _1-D	Shannon_H	Evenness_e^H/S	Margalef
1	*An. nigerrimus*	196	0.1462	0.8762	2.23	0.7751	2.084
2	*An. peditaeniatus*	187	0.113	0.887	2.289	0.8966	1.902
3	*An. culicifacies*	288	0.1395	0.8605	2.127	0.7629	1.766
4	*An. stephensi*	199	0.1291	0.8709	2.215	0.7637	2.078
5	*An. subpictus*	195	0.148	0.852	2.092	0.7364	1.896
6	*An. Vagus*	278	0.137	0.863	2.142	0.7742	1.777

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REFERENCES

1. APHA: American Public Health Association (2005). Standard methods for the examination of water and waste water, 21st ed., Washington, DC: APHA.
2. Attaullah, Zahoor MK, Nasir S, Rasool B, Sultana K, Qamar S and Majeed HN. Assessment of diversity and abundance of Mosquitoes from rural areas of Faisalabad. *Journal of Biodiversity and Environmental Sciences*, 2015; 7(1): 77-87.

3. Balasubramanian R and Nikhil TL. Mosquito (Diptera: Culicidae) fauna in Alappuzha and Kottayam district of the Kerala state, south India. *Journal of Entomology and Zoology Studies*, 2013; 1(6): 134-137.
4. Barraud PJ. The fauna of British India, including Ceylon and Burma. Taylor and Francis, London, 1934; 5: 1-463.
5. Belkin JN. The mosquitoes of the South Pacific (Diptera: Culicidae)., University California Press, Berkeley, 1962; 1.
6. Bram RA. Contributions to the mosquito fauna of Southeast Asia II. The genus *Culex* in Thailand (Diptera: Culicidae). Contributions to the American Entomological Institute, 1967; 2(1): 1- 296.
7. Brown BV. Flies, gnats and mosquitoes. In: Levin SA (Ed). Encyclopedia of Biodiversity. Academic Press, London, 2001; 815-826.
8. Chandrasekar S, Sundaravadivelan C, Sevarkodiyone SP, Mariselvan M and Ramesh U. Study on the Density of Mosquitoes in a Dry Area from Keela, Arunachalapuram, Vilathikulam Taluk, Tamil Nadu, India. *International Journal of Environmental Sciences*, 2012; 2(4): 2167-2172.
9. Chapman AD. *Numbers of Living Species in Australia and the World.* 61. Canberra: Australian Biological Resources Study, Publications, 2006. http://www.environment.gov.au/biodiversity/abrs/publications/other/species-numbers/2006/index.html.
10. Christopher BR. The fauna of British India including Ceylon and Burma, Diptera, tribe Anopheline (Tailor and Francis, London), 1933; 4: 371.
11. Devi N and Jauhari RK. Altitudinal distribution of mosquitoes in mountainous area of Garhwal region: Part–I. *Journal of Vector Borne Diseases*, 2004; 41: 17–26.
12. Foote BA. Order Diptera. 690-915. In: Stehr FW (Ed). Immature Insects. Kendall/Hunt Publishing, Dubuque, Iowa, 1987; 2: 975.
13. Hanafi-Bojd AA, Vatandoost H, Oshaghi MA, Charrahy Z, Haghdoost AA, Sedaghat MM, Abedi F, Soltani M and Raeisi A. Larval habitats and biodiversity of anopheline mosquitoes (Diptera: Culicidae) in a malarious area of southern Iran. *Journal of Vector Borne Diseases*, 2012; 49: 91–100.
14. Hati AK, Chatterji KK and Biswas D. Some new approaches for determining critical density of *Anopheles stephensi* in Calcutta in relation to malaria transmission. *Journal of parasitology and applied animal biology*, 1992; 1: 71-75.

15. Huang YM. Contributions to the mosquito fauna of Southeast Asia. XIV. The subgenus *Stegomyia* of *Aedes* in Southeast Asia. I- the *scutellaris* group of species. . *Contribution of the American Entomological Institute*, 1972; 9(1): 109.
16. Khan HR, Islam MMd, Akter T, Karim RMd and Farid SMd. Diversity of Mosquitoes and Their Seasonal Fluctuation in Two wards Of Dhaka city. *Journal of Biological Sciences*, 2014; 23(1): 17-26.
17. Malhotra PR and Mahanta HC. Check-list of Mosquitoes of Northeast India (Diptera: Culicidae). *Oriental Insects*, 1994; 28: 125-149.
18. Manoucheri AV, Javadian E, Eshghi N and Motabar M. Ecology of *Anopheles stephensi* Liston in southern Iran. *Tropical and Geographical Medicine*, 1976; 28: 228–32.
19. Merritt RW, Courtney GW and Keiper JB. Diptera. In: Resh VH and Carde RT (Ed). Encyclopedia of Insects. Academic Press, London, 2003; 324-340.
20. Raja Rajeswari A and Nagarajan K. Mosquitoe diversity in Erode district, Tamil Nadu, India. *World Journal of Pharmaceutical Research*, 2017; 6(9): 474-482.
21. Rao TR. The Anophelines of India. Malaria Research Centre, Indian Council of Medical research, New Delhi, 1981; 594.
22. Reiter P. Climate change and mosquito borne diseases. *Environmental Health Perspectives*, 2001; 109: 141-161.
23. Reuben R, Tewari SC, Hiriyan J and Akiyama J. Illustrated keys to species of *Culex* (Culex) associated with Japanese encephalitis in Southeast Asia (Diptera: Culicidae). *Mosquito Systematics*, 1994; 26(2): 75-96.
24. Russell PF and Rao TR. On the ecology of larvae of *Anopheles culicifascies* Giles, in borrow-pits. *Bulletin of Entomology Research*, 1942; 32: 341-361.
25. Sahu SS, Gunasekaran K, Jambulingam P and Krishnamoorthy N. Identification of *Anopheles* fauna in hyperendemic *falciparum* area of Orissa State, India. *Indian Journal of Medical Research*, 2008; 127: 178-182.
26. Sahu SS, Gunasekaran K, Vanamail P and Jambulingam P. Seasonal prevalence and resting behaviour of *Anopheles minimus* Theobald and *An. Fluviatilis* James (Diptera: Culicidae) in east-central India. *Indian Journal of Medical Research*, 2011; 133: 655-661.
27. Sanford MR, Chan K and Walton WE. Effects of inorganic nitrogen enrichment on mosquitoes (Diptera: Culicidae) and the associated aquatic community in constructed treatment wetlands. *Journal of Medical Entomology*, 2005; 42: 766-776.

28. Sathish Kumar BY and Vijayan A. Mosquito Fauna and Breeding Habitats in the Rural Areas of Mysore and Mandya Districts, Karnataka State, India. *Entomology*, 2005; 30(2): 123-129.
29. Sharma SN, Subbarao SK, Choudhury DS and Pandey KC. Role of *An. culicifascies* and *An.stephensi* in malaria transmission in urban Delhi, *Indian journal of malariology*, 1993; 30: 155-68.
30. Simpson I and Roger PA. Impact of agrochemicals on mosquito larvae population in rice fields. *International Rice Research Newsletter*, 1991; 16: 29-30.
31. Sirivanakarn S. Medical entomology studies.-III. A revision of the subgenus *Culex* in the Oriental Region. *Contribution of the American Entomological Institute*, 1976; 12(2).
32. Sithiprasasna R, Lee WJ, Ugsang DM and Linthicum KJ. Identification and characterization of larval and adult Anopheline mosquito habitats in the Republic of Korea: potential use of remotely sensed data to estimate mosquito distributions. *International Journal of Health Geographics*, 2005; 4: 17.
33. Sutherst RW. Global change and human vulnerability to vector borne diseases. *Clinical Microbiology Reviews*, 2004; 17: 136-173.
34. Wilson EO. Threats to Global Diversity. Retrieved, 2009; 2009-05-17.
35. World Health Organization. Manual on practical entomology in malaria vector bionomics and organization of antimalarial activities, Part I and II. Offset publication, No. 13, Geneva, 1975.
36. World Health Organization (2007). Malaria fact Sheet. http://www.who.int /mediacentre/ factsheets/fs094/en/ index.html.