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Research Article

Armigeres with the Highest Man Hour Density in Bhawanipatna, Odisha

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ABSTRACT

Mosquitoes are carrier of some medically and veterinary important pathogens and parasites to humans and animals worldwide. Annually 750,000 deaths occur from Mosquito Borne Diseases (MBDs) so they are known as the deadliest vector in the world. Mosquitoes are vectors of so many different disease agents around the world. Seasonal dynamics and diversity have been seen in mosquitoes in different regions of the world. It has been observed that certain mosquito population is fluctuating in different seasons, causing different mosquito borne human diseases in the same place in different seasons. The authors were interested in assessing the diversity, abundance and dynamics of the mosquito population in Bhawanipatna by collecting of mosquitoes from indoors and outdoors from November 2023 to February 2024. This is the first and unique study in Bhawanipatna helps to understand the dynamics and abundance of mosquitoes in Bhawanipatna. A maximum 411 number of *Armigeres* mosquitoes were collected, followed by 121 number of *Culex* mosquitoes and 42 number of *Anopheles* mosquitoes. The least number of *Aedes* mosquitoes were collected which is 27 numbers. A maximum 248 number of adult *Armigeres* mosquitoes were collected outdoors followed by 28 *Culex* mosquitoes and 27 *Anopheles* mosquitoes outdoors, but the least number of *Aedes* mosquitoes (19 numbers) were collected outdoors. A maximum 163 number of adult *Armigeres* were collected indoors, followed by 53 *Culex* mosquitoes and 15 *Anopheles* mosquitoes from the indoor survey. Very a small number of *Aedes* mosquitoes (08) were collected from the indoor survey. During our survey *Armigeres* had highest MHD in this area with the potential for Zika and other pathogen transmission.

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INTRODUCTION

Mosquitoes are carrier of some medically and veterinary important pathogens and parasites to humans and animals worldwide. Annually 750,000 deaths occur from Mosquito Borne Diseases (MBDs) so they are known as the deadliest vector in the world [1, 2]. The burden of MBDs is highest in tropical and subtropical regions due to poor socioeconomic conditions [3]. The mosquitoes transmit pathogens from infected persons to healthy persons through biting, causing nuisance disease like Malaria, Zika fever, Dengue, Chikungunya, Japanese Encephalitis, Yellow fever, West Nile virus etc. But due to the lack of effective vaccines or specific 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 [4]. Diversity and abundance of mosquito increase in suitable environmental conditions, and changing environmental conditions, enhanced MBDs [5]. More than 3.9 billion in 128 countries are prone to dengue infection with about 96 million dengue cases reported every year [6]. Malaria is one of the deadliest MBDs, which can cause substantial economic and social disruption. Every year nearly 4,00,000 deaths were recorded due to malaria [7]. The Study of mosquito diversity, dynamics and abundance is essential for management and controls of mosquitoes. Mosquitoes belong to the phylum Arthropoda, class Insecta, and order Diptera [8], and are under three subfamilies: Toxorhynchitinae, Anophelinae, and Culicinae [9]. There are over 3,530 species of mosquitoes in the world, which are grouped under 43 genera; all these genera are included in the Culicidae family [10]. From these genera, *Anopheles*, *Aedes*, and *Culex* are medically important due to their ability to transmit mosquito-borne human diseases [11]. Some mosquito species bite humans routinely and act as vectors of several infectious diseases affecting millions of people annually [12]. In India 404 species of mosquitoes which are grouped under 50 genera [13].

Seasonal dynamics and diversity have been seen in mosquitoes in different regions of the world. It has been observed that certain mosquito population is fluctuating in different seasons, causing different mosquito borne human diseases in the same place in different seasons. With this backdrop, the authors were interested in assessing the diversity, abundance and dynamics of the mosquito population in Bhawanipatna by collecting of mosquitoes from indoors and outdoors from November 2023 to February 2024. This is the first and

unique study in Bhawanipatna helps to understand the dynamics and abundance of mosquitoes in Bhawanipatna. It will be helpful to control and to make strategies to prevent MBDs in particular seasons.

METHODS AND STUDY AREA

Method

The mosquito collection was carried out by the authors using a manual aspirator. The author acted as both a mosquito feeder and a catcher. The authors wore closed clothes except on the lower legs. If a mosquito landed, it was caught using an aspirator. The trapped mosquitoes were immediately put into a gauze-covered glass test tube marked by the date, time and location. The authors did not use apply repellents or fragrances on their bodies, smoke, or burn anything in the vicinity of the fishing grounds. Mosquitoes perching on the lower body parts were struck using a manual aspirator. Mosquito identification was carried out based on the guidelines in Rampa Rattanirithikul Mosquito Identification Key Book [14-20]. The authors identified all mosquitoes up to the genus level. All the collected data were analyzed to determine mosquito density stated as Man Hour Density (MHD). MHD is the number of mosquitoes that bite people per hour at a specific time of the day. MHD is determined by the number of mosquitoes, which land on a feeder's limb and are successfully captured, divided by the number of catchers multiplied by the time of capture in hours.

Study Areas The collection of data was made from different locations of Bhawanipatna Municipal Corporation, the Headquarter of the district of Kalahandi. Bhawanipatna is located at 19.9°N 83.17°E, has a tropical wet and dry climate, and the annual average rainfall is 1300mm. The municipality has a population of 69,045 of which 35,506 are males while 33,539 are females residing in around 16,500 houses as per a report released by census India 2011.

Fig.01 Map of Bhawanipatna, Kalahandi District, Odisha

RESULTS AND ANALYSIS

The number of mosquitoes collected in different locality of Bhawanipatna municipality Kalahandi district for 17 hours from 06:00 AM to 11:00 PM was 601 adult mosquitoes from November 2023 to February 2024. Mosquitoes were identified and the identification of captured

mosquitoes resulted in 4 genera, *Armigeres, Culex, Aedes,* and *Anopheles.*

A total 411 of *Armigeres* adult mosquitoes were collected during the survey, out of 163 collected inside the house and 248 collected outside the house. A total of 121 adult C*ulex* mosquitoes were caught, out of which 53 were collected inside the house and 68 were collected outside the house. In the case of the *Aedes* survey total 08 numbers of adult mosquitoes were collected indoor and 19 adult mosquitoes were collected outdoor. A total 27 number of adult *Aedes* mosquitoes were caught during the survey. A total 42 number of adult *Anopheles* mosquitoes were collected during the survey, 15 were collected indoor and 27 were collected outdoor **(Table 1).**

A maximum 411 number of *Armigeres* mosquitoes were collected, followed by 121 number of *Culex* mosquitoes and 42 number of *Anopheles* mosquitoes. The least number of *Aedes* mosquitoes were collected which was 27 numbers. A maximum 248 number of adult *Armigeres* mosquitoes were collected outdoors followed by 28 *Culex* mosquitoes and 27 *Anopheles* mosquitoes outdoors, but the least number of *Aedes* mosquitoes (19 numbers) were collected outdoors. A maximum 163 number of adult *Armigeres* were collected indoors, followed by 53 *Culex* mosquitoes and 15 *Anopheles* mosquitoes from the indoor survey. Very a small number of *Aedes* mosquitoes (08) were collected from the indoor survey **(Table 1& Fig. 3)**.

Man-hour density (MHD) of *Armigeres* had gradually decreased from 06:00 AM to 11:00 AM but in our survey, there was no collection record between 11:00 AM to 02:00 PM. Again, there was a gradual increase of MHD of *Armigeres* from 02:00 PM to 07:00 PM; however, there was a gradual decreasing of *Armigeres* from 08:00 PM to 10:00 PM. The maximum MHD of *Armigeres* was recorded from 06:00 PM to 07:00 PM **(Table 2& Fig. 2)**. The maximum MHD of *Armigeres* (96) was followed by 85 MHD at 07:00 PM to 08:00 PM, 82 MHD at 05:00 PM to 06:00 PM, 47 MHD at 08:00 PM to 09:00 PM, 16 MHD at 03:00 PM to 04:00 PM and 4 MHD at 02:00 PM to 03:00 PM followed by 03 MHD at 09:00 PM to 10:00 PM during afternoon hour. But the maximum MHD of *Armigeres* recorded at 06:00 AM to 07:00 AM followed by 17 MHD at 07:00 AM to 08:00 AM and so on during the morning hour **(Table 2 & Fig. 2)**.

A similar observation was made in the MHD of *Aedes*, there was a gradual decrease in MHD from 06:00 AM to 09:00 AM during the morning hour. There was no record of MHD of *Aedes* from 09:00 AM to 04:00 PM. But again, a gradual increase

and decrease of MHD of *Aedes* was observed from 04:00 PM to 08:00 PM. A maximum 9 MHD of *Aedes* was recorded from 06:00 PM to 07:00 PM and the least MHD of *Aedes* (01) was observed from 07:00 PM to 08:00 PM hour, however, there was no caught of *Aedes* adult mosquito from 08:00 PM to 11:00 PM **(Table 2 & Fig. 2)**.

Another observation was made in the MHD of *Culex*, there was a gradual decreasing of MHD from 06:00 AM to 09:00 AM during the morning hour. After that, there was no observation of MHD of *Culex* from 09:00 AM to 04:00 PM in our survey. Again, there was a gradual increase in the MHD of *Culex* from 04:00 PM to 11:00 PM. Maximum MHD of *Culex* (42) was followed by 24 MHD of *Culex* from 09:00 PM to 11:00 PM, 17 MHD from 08:00 PM to 09:00 PM, and 12 MHD from 07:00 PM to 08:00 PM during afternoon hours. However, the least number of MHD of *Culex* was observed between 04:00 to 06:00 PM **(Table. 2 & Fig. 2)**.

The MHD of *Anopheles* had no record in our survey during the morning hour. However, there was a gradual increase of MHD of *Anopheles* from 07:00 to 11:00 PM during the evening hour. The maximum MHD (15) at 10:00 to 11:00 PM, 11 MHD at 09:00 to 10:00 PM, 10 MHD at 08:00 to 09:00 PM and 6 MHD at 07:00 to 08:00 PM during evening hours. However, the maximum MHD of *Anopheles* was recorded at 10:00 to 11:00 PM **(Table 2 & Fig. 2)**.

Table: 1 Showing number of collected mosquito's genus-wise from the indoor and the outdoor survey in Bhawanipatna.

	Collected Mosquitoe Genus							
	Armigeres		***Culex***		***Aedes***		***Anopheles***	
	Indoor	***Outdoor***	***Indoor***	***Outdoor***	***Indoor***	***Outdoor***	***Indoor***	***Outdoor***
November 2023	33	41	11	09	03	06	01	09
December 2023	35	61	16	18	02	08	03	06
January 2024	47	69	13	21	00	02	03	09
February 2024	48	77	13	20	03	03	08	03
Total	**163**	**248**	**53**	**68**	**08**	**19**	**15**	**27**
	411		**121**		**27**		**42**	
	601							

Table: 2 Showing Man per Hour Density (MHD) of different mosquito genera with respect to time.

Time	06:00-06:59	07:00-07:59	08:00-08:59	09:00-09:59	10:00-10:59	11:00-11:59	12:00-12:59	13:00-13:59	14:00-14:59
MHD of *Armigeres*	35	17	09	08	02	0	0	0	04
MHD of *Aedes*	08	03	01	0	0	0	0	0	0
MHD of *Culex*	11	04	01	0	0	0	0	0	0
MHD of *Anopheles*	0	0	0	0	0	0	0	0	0
Time	**15:00-15:59**	**16:00-16:59**	**17:00-17:59**	**18:00–18:59**	**19:00-19:59**	**20:00-20:59**	**21:00-21:59**	**22:00-22:59**	
MHD of *Armigeres*	07	16	82	96	85	47	03	00	
MHD of *Aedes*	0	02	05	09	01	0	0	0	
MHD of *Culex*	0	02	01	07	12	17	24	42	
MHD of *Anopheles*	0	0	0	0	06	10	11	15	

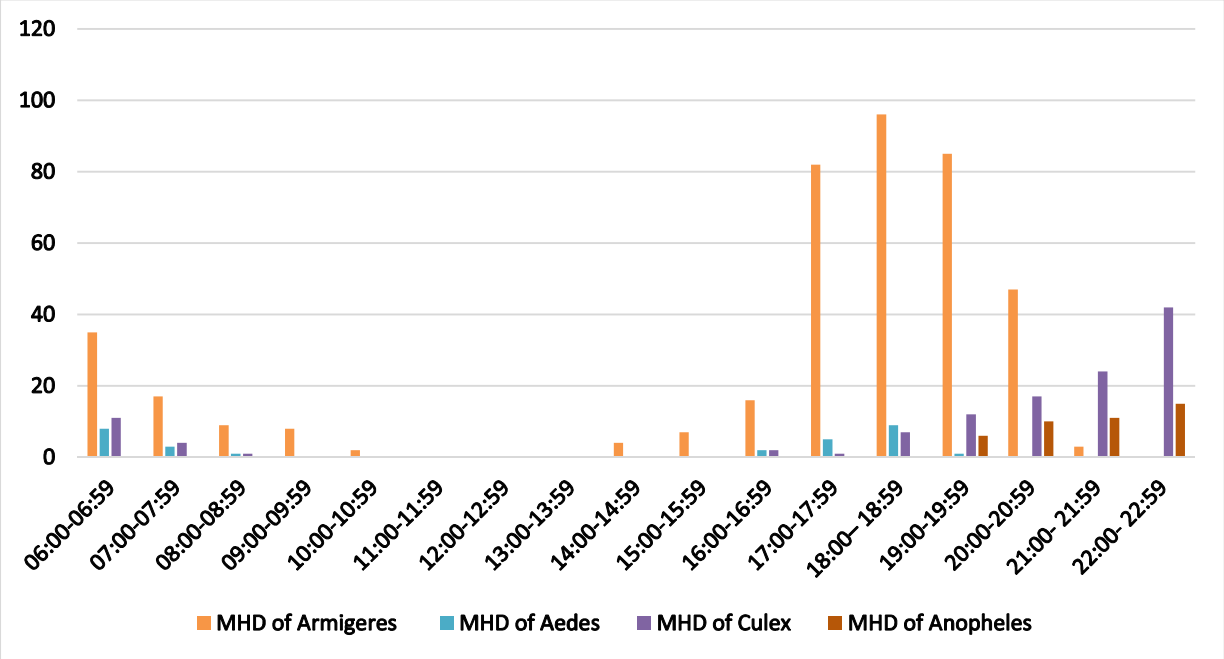

Fig.2 Showing hour-wise MHD of mosquitoes belonging in four genera

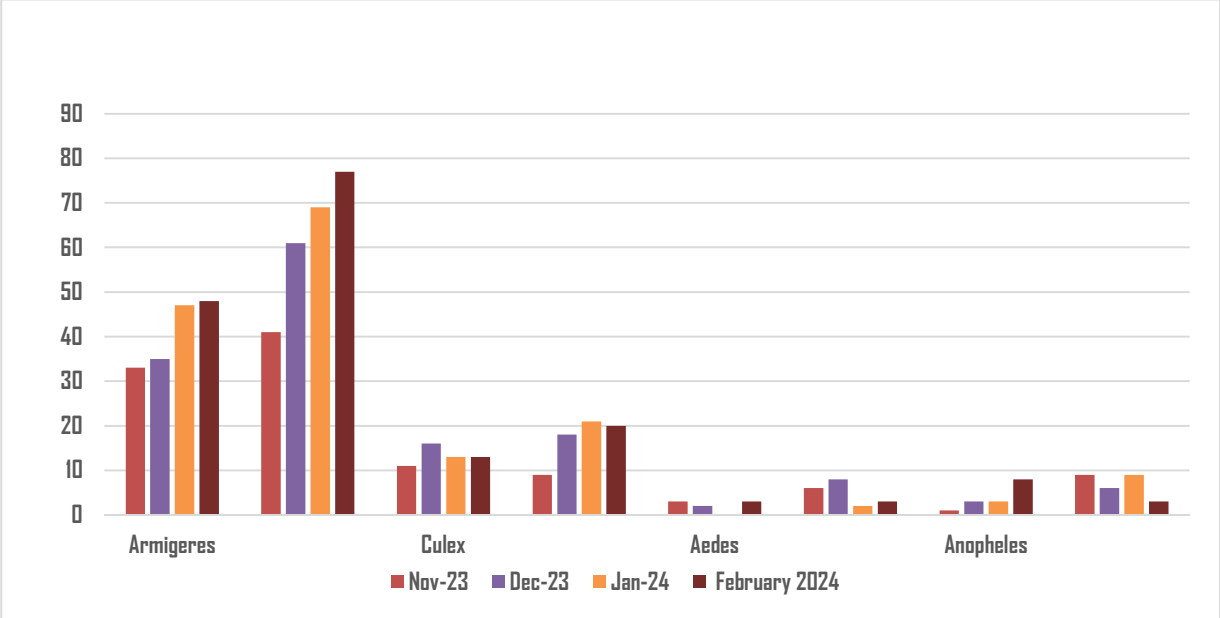

Fig.03 Showing month-wise total number of collected mosquitoes belonging in four different genera

DISCUSSION

Our survey was conducted at the end of winter and on the set of summer. In the 17-hour survey per day for four months in Bhawanipatna, Kalahandi, Odisha, it was found that *Armigeres* had the highest MHD compared to the other mosquitoes **(Figure 02)**. This is the surprising and the first finding of *Armigeres* caught in the highest number and this shows that the possibility of humans being bitten by *Armigeres* is higher than by the other mosquitoes, namely *Culex, Aedes,* and *Anopheles.* Previous studies also found the highest percentage of *Aedes* in Bhawanipatna [21] during the rainy season. So, the population of mosquitoes belonging to different genera varies according to the variations of different environmental factors in Bhawanipatna. Recently it was reported that the presence of *Armigeres subalbatus* with high MHD increases the risk of Zika virus transmission [22]. This town was potentially at risk of different *Aedes* Borne Diseases (ABD) in rainy seasons [21] but in spring it was at risk for Zika. Consequently, a high number of infected mosquitoes are needed to transmit the disease. Although Bhawanipatna is not an endemic area of Zika, a high density of *Armigeres* was found in this area with the potential for Zika transmission.

The activity of mosquitoes inside and outside the home is related to the

transmission pattern of Zika. The MHD of *Armigeres* showed a higher figure outside the house than in the house **(Table 1& Fig. 2)**. This indicates that the risk of individuals coming into contact with mosquitoes outside the home is higher than inside the house, resulting in a corresponding higher risk of contracting Zika from outside. Zika preventive measures can be taken by avoiding outdoor activities in the evening hours or wearing closed clothes outside the home during an outbreak of Zika. In addition, the residents have a habit of staying outside the house at evening hours often without wearing tops, particularly done by men during summer. Also, many houses are densely occupied by mosquitoes, making Zika transmission easy to occur. Stagnant water that persists for several weeks is a breeding ground for mosquitoes. The existence of vector mosquitoes may allow transmission of Zika in this area. Stagnant water is one of the larval habitats suitable for *Armigeres* in addition to other habitat types, such as shallow wells and blocked channels. In our survey, we found these types of mosquito breeding sites around the cattle shed, becoming the potential breeding sites for *Armigeres* and other mosquitoes like *Culex* and *Anopheles.* Mosquito breeding sites in the form of sewerage or sewers found in Bhawanipatna. The mosquito larvae found in the sewers were reared in the laboratory until they were adults and identified as *Armigeres subalbatus*, not included in our study. This showed that the mosquito breeding cycle continues and has the potential for the spread of Zika and other diseases. Sewage in a household waste disposal channel contains several organic and inorganic substances. This water may be a more suitable medium for mosquito breeding.

CONCLUSIONS

The population density of mosquitoes belonging to different genera varies according to the variations of different environmental factors in different seasons in Bhawanipatna. This town was potentially at risk of different *Aedes* Borne Diseases (ABD) in rainy seasons but in spring it was at risk for Zika. Consequently, a high number of infected mosquitoes are needed to transmit the disease. Although Bhawanipatna is not an endemic area of Zika, a high MHD of *Armigeres* was found in this area with the potential for Zika transmission.

DECLARATION

There is no conflict of interest in publishing this research article.

REFERENCES

1. Mobin M, Khan M, Anjum H, Rahman H, Marzan M et al. (2022).

Knowledge, Attitudes, and Practices in Relation to MosquitoBorne Diseases in Bangladesh. International Journal of Environmental Research and Public Health 19 (14): 8258. https://doi.org/10.3390/ijerph19148258

2. Nebbak A, Almeras L, Parola P, Bitam I (2022). Mosquito Vectors (Diptera: Culicidae) and Mosquito-Borne Diseases in North Africa. Insects 13 (10): 962. https://doi.org/10.3390/ insects13100962
3. Franklinos, L. H., Jones, K. E., Redding, D. W., & Abubakar, I. (2019). The effect of global change on mosquito-borne disease. *The Lancet infectious diseases*, *19*(9), e302-e312.
4. El-Kersh T A, Ahme, A M, Al-Sheikh Y A, Tripet F, Ibrahim M S, Metwalli A. A. 2016. Isolation and characterization of native Bacillus thuringiensis strains from Saudi Arabia with enhanced larvicidal toxicity against the mosquito vector Anopheles gambiae. Parasites & vectors 9(1): 1-14.
5. Attaullah M, Gul S, Bibi D, Andaleeb A, Ilahi I et al. (2021). Diversity, distribution and relative abundance of the mosquito fauna (Diptera: Culicidae) of Malakand and Dir Lower, Pakistan. Brazilian Journal of Biology 83(https://doi.org/10.1590/1519-6984.247374
6. World Health Organization. 2022. Dengue / Fact sheet 2022. https://www. who.int/news-room/fact-sheets/detail/dengue-and-severe-dengue
7. World Health Organization. 2018. World health statistics 2018: monitoring health for the SDGs, sustainable development goals. https://www.who.int/docs/default-source/gho-documents/worldhealth-statistic-reports/6-june-18108-world-health-statistics-2018.
8. R. Gaugler, *Medical Entomology for Students*, Oxford University Press, Oxford, UK, 2016.
9. G. R. Mullen and L. A. Durden, *Medical and Veterinary Entomology*, Academic Press, Cambridge, MA, USA, 2009.
10. G. C. Goutam Chandra, A. G. Anupam Ghosh, I. B. Indranil Bhattacharjee, and S. K. Ghosh, "Use of larvivorous fish in biological and environmental control of disease vectors," *Biological and Environmental Control of Disease Vectors*, CABI, Boston, MA, USA, 2013.
14. View at: Publisher Site | Google Scholar
11. D. J. Gubler, "The global threat of emergent/re-emergent vector-borne

diseases," in *Vector Biol, EcolCont*, pp. 39–62, Springer, New York, NY, USA, 2010.

15. View at: Publisher Site | Google Scholar
12. Adugna, F., Wale, M., &Nibret, E. (2021). Review of Anopheles mosquito species, abundance, and distribution in Ethiopia. *Journal of tropical medicine*, *2021*, 1-7.
13. Tyagi, B. K., Munirathinam, A., & Venkatesh, A. (2015). A catalogue of Indian mosquitoes. *International Journal of Mosquito Research*, *2*(2), 50-97.
14. R. Rattanarithikul, B. A. Harrison, P. Pantusiri, and R. E. Coleman, "Illustrated keys to the mosquitoes of Thailand I," Southeast Asian J. Trop. Med. Public Health, vol. 36, no. Supplement 1, pp. 1–81, 2005.
15. Rattanarithikul R, Harbach RE, Harrison BA, Panthusiri P, and Jones JW, "Illustrated keys to the mosquitoes of Thailand II. Genus Culex," Southeast Asian J Trop Med Public Heal., vol. 36, no. supplemen 2, p. 97, 2005.
16. Rattanarithikul R, Harrison BA, Panthusiri P, Peyton EL, and Coleman RE, "Illustrated Keys to the Mosquitoes of Thailand III. Genera Aedemyia, Ficalbia, Mimomyia, Hodgesia, Coquilletidia, Mansonia and Uranotenia," Southeast Asian J Trop Med Public Heal., vol. 37, no. suppl 1, p. 85, 2006.
17. Rattanarithikul R, Harrison BA, Harbach RE, Panthusiri P, and Coleman RE, "Illustrated Keys to Mosquitoes of Thailand IV. Anopheles," he Southeast Asian J Trop Med Public Heal., vol. 37, no. suppl 2, p. 128, 2006.
18. Rattanarithikul R, Harbach RE, Harrison BA, Panthusiri P, and Coleman RE., "Illustrated Keys to the Mosquitoes of Thailand V. genera Orthopdomyia, Kimia, Malaya, Topomyia, Tripteroides and Toxorrhynchites," Southeast Asian J. Trop. Med. Public Heal. , vol. 38, no. supplement 2, 2007.
19. R. Rattanarithikul, R. Harbach, B. Harrison, P. Panthusiri, R. Coleman, and J. Richardson, "Illustrated Keys to the Mosquitoes Thailand VI. Tribe Aedini," Southeast Asian J. Trop. Med. Public Health, vol. 41, no. supplement 1, p. 225, 2010.
20. R. Rattanarithikul, B. A. Harrison, and R. E. Harbach, "Illustrated Keys to the Mosquitoes of Thailand," Southeast Asian J. Tropmed. Public Health, vol. 37, no. Supplement 2, 2006.
21. Panigrahi, S. K. (2021). Research Article Survey of Aedes Mosquito Breeding Sites, Density and Pattern of Distribution: An Approach to Manage Dengue Outbreaks in Bhawanipatna

Town, Odisha, India. Research Journal of Pharmacy and Life Sciences: Volume, 2(3), 46-65.

22. Li CX, Guo XX, Deng YQ, Liu QM, Xing D, Sun AJ, et al. Susceptibility of ArmigeressubalbatusCoquillett (Diptera: Culicidae) to Zika virus through oral and urine infection. PLoSNegl Trop Dis. 2020; 14(7): e0008450.