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Studies on taxonomy of genus *Culex* (L.) (Diptera: Culicidae) in Aurangabad city, Maharashtra state, India

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Abstract
Taxonomy plays important role in species correct identification and also in the field of applied biology including public health, pest management, environment problems, nutritional science, forensic science, and several other fields in identifying the species. The present study deals with the taxonomy of the mosquito genus *Culex* from different habitats of Aurangabad city of Maharashtra, India. The study was carried out from June 2018 to May 2019. The species of Genus *Culex* such as *Culex vishnui, Culex psedovishnui, Culex quinquefasciatus and Culex tritaeniorhynchus* were recorded during the present study. The specimens of mosquitoes were identified as per the standard methodology suggested by Christoper (1933), Chester J. Stojanovich (1994), Leopoldo M. Rueda (2004), Nagpal, and Tingare (2010).

Keywords: taxonomy, *Culex, Culex pseudovishnui, Culex quinquefasciatus, Culex vishnui,* culicidae, Aurangabad city

Introduction

Mosquito belongs to phylum Arthropoda, class Insecta, subclass Nemetocera, order Diptera and Family: Culicidae. The tribe Cilicini is second largest group of mosquitoes consisting of diverse collection with cosmopolitan distribution. The *Culex* is a large genus with 768 species belonging to 26 subgenera Harbach (2011) [1]. *Culicidae* presently has 3,543 species and they distributed different types of habitats and ecosystems around the world Harbach (2015) [13]. Mosquitoes have been menace to world for spreading diseases in different ways and sometimes severe illness and death. They are vectors for animals, birds, and humans. Genus *Culex* species are worldwide mosquito species in the world (Bhattacharya *et al.,* 2016) [2]. They feed both animals and humans and such type of behavior rise their potential to transfer Zoonotic diseases and that is the main threat to public health (Weissenbock *et al*., 2010) [3]. *Culex* mosquitoes are the main threat to public health, being ranked with the genera of *Anopheles* and *Aedes* in the transfer of epidemiologically important diseases (Lane *et al*., 1993, Sachs *et al*., 2002) [4, 5].

Mosquito is a serious disease-causing agent and they spread more diseases by acting as vectors globally. *Culex pipiens* are present on all continents (Nchoutpouen E, *et.al* 2019) [22]. The common names for this mosquito are domestic mosquito because it prefers to bite inside homes in the evening or at night. This mosquito lives in urban environments with mild temperatures. It is generally found in waters rich in organic matter. It is observed in septic tanks, sand traps of sewer mouths, poorly maintained swimming pools and rainwater plates. Mosquito is mainly a vector of many diseases. Mosquitoes are proven as well as they are suspected vectors of encephalitis, West Nile and Raft Valley fever viruses, microfilariae, and a variety of encephalitis (Turell *et al*.,2012, Irish *et al*., 2018) [6, 7]. In the world, more than 20 nations are endemic with Japanese encephalitis is a serious problem (Kumar 2014) [12]. *Cx pipiens* is present in southwestern mountains and *cx. quenquefasciatus* are present more in Arabian Peninsula. (Harbach 1988) [8]. In *Culex* mosquitoes palpi are shorter than the proboscis measuring one-fourth length of a proboscis with rare ornamentation, trilobed thorax, dark color and pale color band are notably present on abdominal segments. The *Culex* mosquito shows a surface parallel position when they are present at rest. For *Culex* mosquitos breeding sites are different mainly in sewage water canals, ditches, containers, temporary waterlogged areas plastic, polluted water, earthen pots, discarded tires, etc. (J.C. Kalita *et al*., 2014) [23]. The study of *Culex* mosquitoes is important because they are significantly responsible for the transmission of many diseases and act as vectors of lethal diseases such as lymphatic filariasis, Japanese encephalitis, West Nile virus, and avian malaria (Bansal *et al*., 1994) [9]. The *Culex* genus is medically important since many species act as vectors of diseases like West Nile virus, lymphatic filariasis, St. Louis encephalitis, avian malaria Japanese encephalitis, (Reuben net *et al*., 1988) etc. [10].

The main objective of the study is to collect and investigate the different species of the *Culex* genus from Aurangabad city of Maharashtra India. Genus *Culex* is widely spread and has the greatest economic importance for its role in spreading various diseases. However, its component species show a good deal of variations confusing their true status. Accordingly, the genus *Culex* needs to be studied intensively in different areas for true identification of the species and the benefit of health officials in different localities. For this purpose, Aurangabad has been selected for such a detailed study. These efforts have succeeded in procuring 4 *Culex* species for this area which have been subjected to the taxonomic status of each species.

Material and Methods

The present study was conducted from June 2018 to May 2019 in Aurangabad city of Maharashtra State India. Random collections were carried out in 12 sampling sites in Aurangabad city and surrounding villages. The adult

mosquitoes were collected by mouth aspirator, with help of torchlight etc. and collection was also done using different sampling methods such as larval collection, hand catch and pyrethrum space spray etc. The dissimilar phases of mosquito larvae were collected and transferred with a glass sucking pipette and to glass beakers separately for each location and carried to the laboratory. Rearing of larvae was carried out in the laboratory and preservation of adult mosquito in cork tubes. The preserved mosquitoes were identified as per standard key Das *et al*., (1990), Rueda *et al*., (2004) Rattanarithikul *et al.* (2005), Christoper (1933), Chester J. Stojanovich (1994), Leopoldo M. Rueda (2004), Nagpal and Tingare (2010) using stereoscopic microscope.

Results and Discussion

During the present study, four species belonging to the genus *Culex* were reported that including *Culex vishnui, Culex pseudovishnui, Culex quinquefasciatus, and Culex tritaeniorhynchus.*

Taxonomy

Phylum: Arthropoda
Class: Insecta
Order: Diptera.
Suborder: Nemetocera.
Family*: Culicidae*
Genus*: Culex*

Keys to the genus *Culex*: (Harry D. Pratt and Chester.J. Stojanavich.1994)

Palp much shorter than proboscis, proboscis slender and never downward, abdominal tergites with pale bands or lateral spots, postnotum without setae, abdomen blunt, base of subcosta without a row of bristles on the underside, most of the wing scales at the base of wing narrow dark, antenna are not longer than proboscis, the first flagellar segment about as long as following segment……*Culex*

Keys for species Genus *Culex*: (Harry D. Pratt and Chester.J. Stojanavich.1994)

Several scattered pale scales with wing and scutal integument light brown; the anterior surface of hind femur with pale stripe not contrasting with dark scaled area.....*C. Vishnui*

The area pre-scutellar covered pale scales, pale stripe present on anterior surface contrasting well with dark areas……...
C. pseudovishnui

Hind tarsus was entirely dark. Wing clear palps shorter than proboscis. Abdomen with rounded pale bands, abdomen with broad bands. Thorax without spots. Proboscis straight, smaller mosquito usually with blackish or brownish color, scutellum tri-lobed, abdomen with scales, mesonotum almost uniform scales, coarse and brassy abdomen blunt with pale basal bands rounded, the wing with a second marginal cell at least as long as its petiole……
……..……..*C.quinquefasciatus*

Pale patch present on proboscis and stripe on the ventral surface, pale color hind femur and dark ring apical has present, and straight scales on vertex all dark color ……*C. tritaeniorhynchus*

***Culex vishnui* (Theobaldi 1909)**

Diagnostic Character

Proboscis and tarsi with bands. The pale scaled area on the hind femur. Straight scales of vertex entirely brown, straight scales in center of vertex lightly golden color but not contrasting sharply with darkened erect scales on lateral or posterior and side by side areas. Only femora are speckled. Based on the proboscis may be speckled or not. Vertex pale color. The endpoint of the abdomen is rounded and the white spot- on the wing is absent. *Culex vishnui* is a common mosquito in India. *Culex vishnui* is commonly distributed in Maharashtra, such as Nagpur, and Ahmednagar City [14, 15]. This species is present in Tamilnadu (Anandh *et al*., 2017) [16].

***Culex pseudovishnui* (Theobald 1901)**

Diagnostic Character

The midpoint on the Proboscis presents a pale ring, sometimes with short setae present, the endpoint of the abdomen is blunt and a band present on them. The prior surfaces of the hind femur with very distinct white stripes on thorax without speculation. Narrow basal pale bands. Terga with a very narrow basal dim pale band which progressively decreases in width towards the posterior segment. *Culex Pseudovishnui* in India was reported in Tamilnadu (Coimbatore), and Karnataka (Bellary) (Manimegalai *et al*., 2010, Kanojia, 2007) [17, 20]. They reported in Maharashtra Nagpur, Ahmednagar city (Karlekar *et al.,* 2015, Ramdas *et al*., 2017) [14, 15].

***Culex quenquefasciatus* (Say 1823)**

Diagnostic Character

Cx. quinquefasciatus is a marked domestic species acting as a vector of lymphatic filariasis inadequate drainage systems are responsible for its increased dispersal, and its strong-winged species are found all over India mainly in human dwellings (Reuben *et al.*, 1988) [10]. *Cx. quenquefasciatus* was the predominant species in North Coimbatore, Tamil Nadu, followed by *cx. pseudovishnui* (Senthamarai *et al.,* 2016) [11]. The adult is a moderate size mosquito and is brownish or coffee in color. Their body size is 3.90 to 4.20 mm long. Post spiracular area without the pale patch. Wing without distinct pale patches. The 2 pale spots are absent on the mesonotum, the main body is brownish, and the wing, proboscis, thorax, and tarsi are dark in color than the rest of the body. The length of antennae and proboscis same length and in some cases time they are one-fourth length of them. 13 segments are present on the flagellum and there have no scales. The abdomen has a rounded broad pale band, and a coffee color and pale brownish color are seen in the scutal integument present and thoracic no dark stripes. This species has a blunt abdomen male and female is feed on the nectar of plants but the female has feed the human blood when they ready for egg laytime. The scutellum is tri-lobed, abdomen with scales and pale bands. The *Cx. quinquefasciatus* egg is cigar-shaped they float on top of the water surface. This species was reported in Guwahati city of Assam, Coimbatore in Tamilnadu, India (Alak *et al*., 2014, Manimegalai, 2010) [19, 17].

***Culex tritaeniorhynchus* (Giles 1901)**

Diagnostic character

The beginning surface of the fore, mid femora is dark scales. Straight scales on vertex dark in color. The prior anteriorly surface of the hind femur is dim white color

scaled with a tapering black scaled ring apically scutum covered with dark coppery gold scales. Proboscis with the broad median pale band with the accessory pale band. Unicolor dark scales present scutum; acrostichal setae seen; pleuron have patches present. tarses have pale bands, and the wings are different than other species they are vein R2+3 dark scaled less than R2 vein, and only terga have pale basal bands. *Culex tritaeniorhynchus* in India reported in Assam in Guwahati city, Bellary District in Karnataka, In Alappuzha, and Kottayam District in Kerala (Alak *et al*., 2014 Kanojia *et al*.,*2007*, Balasubramanian *et al*., 2013) [19, 20, 21].

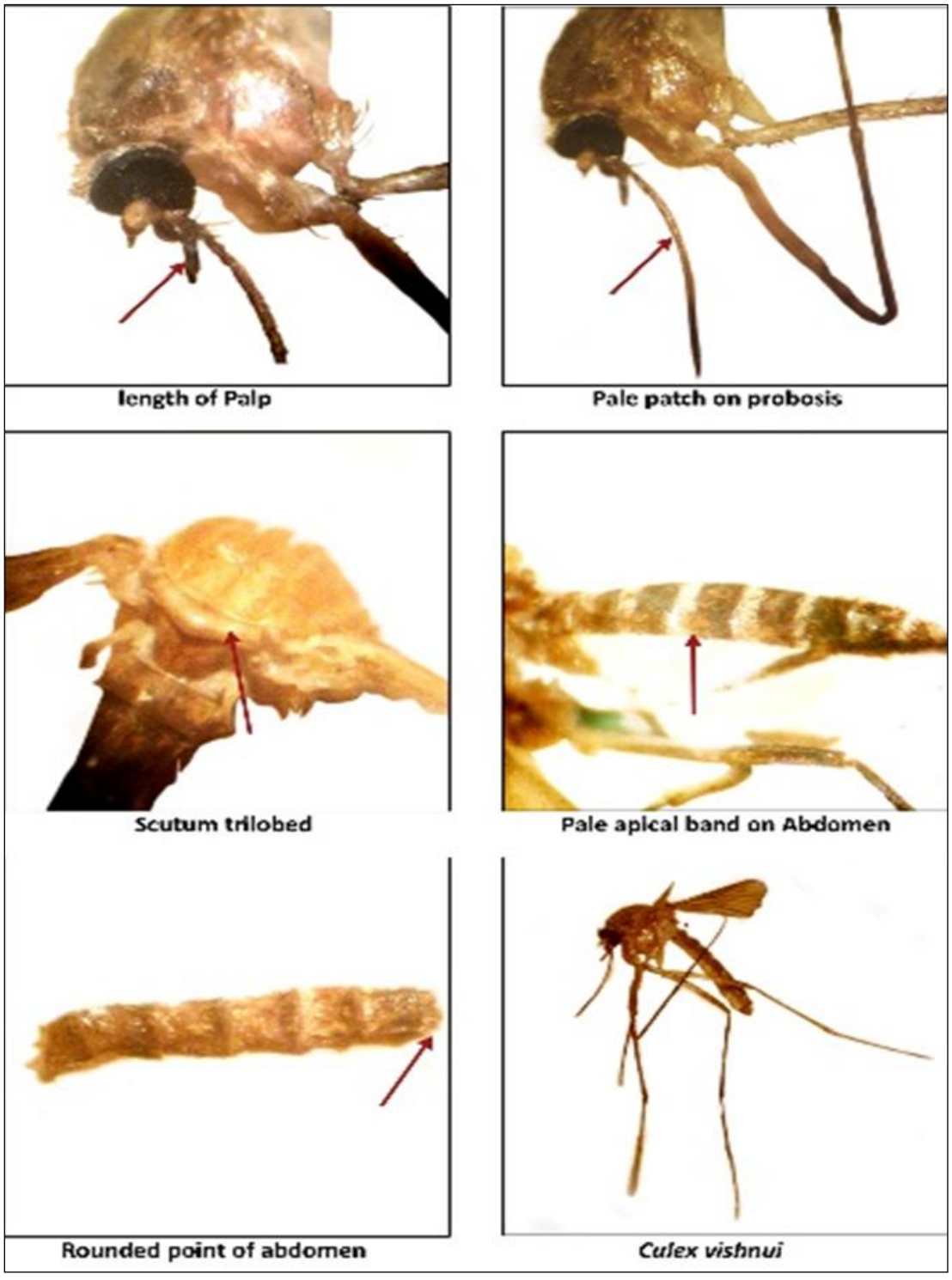

Plate 1: Culex Vishnui

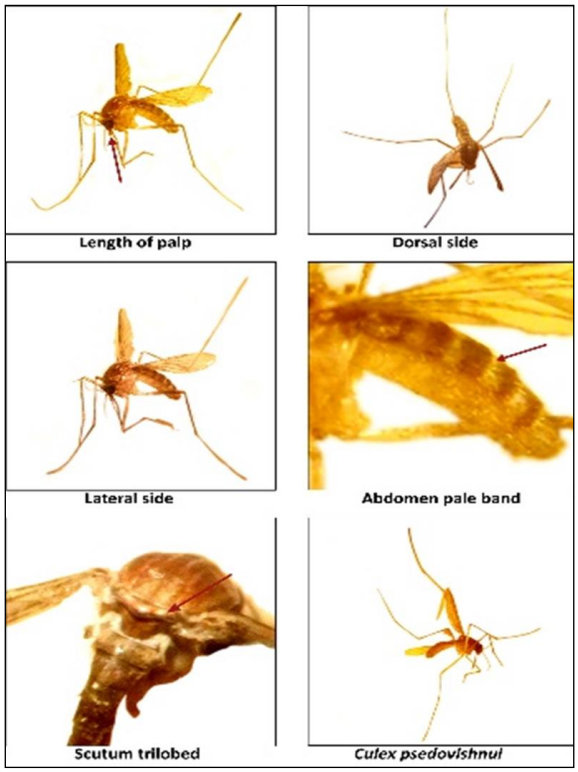

Plate 2: Culex Psedovishnui

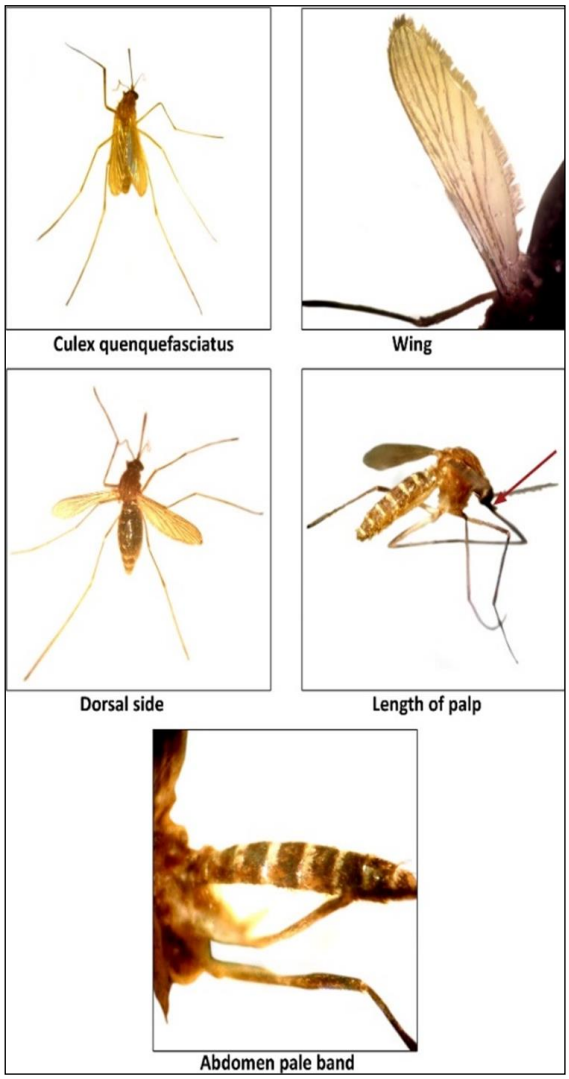

Plate 3: Culex Quenque fasciatus

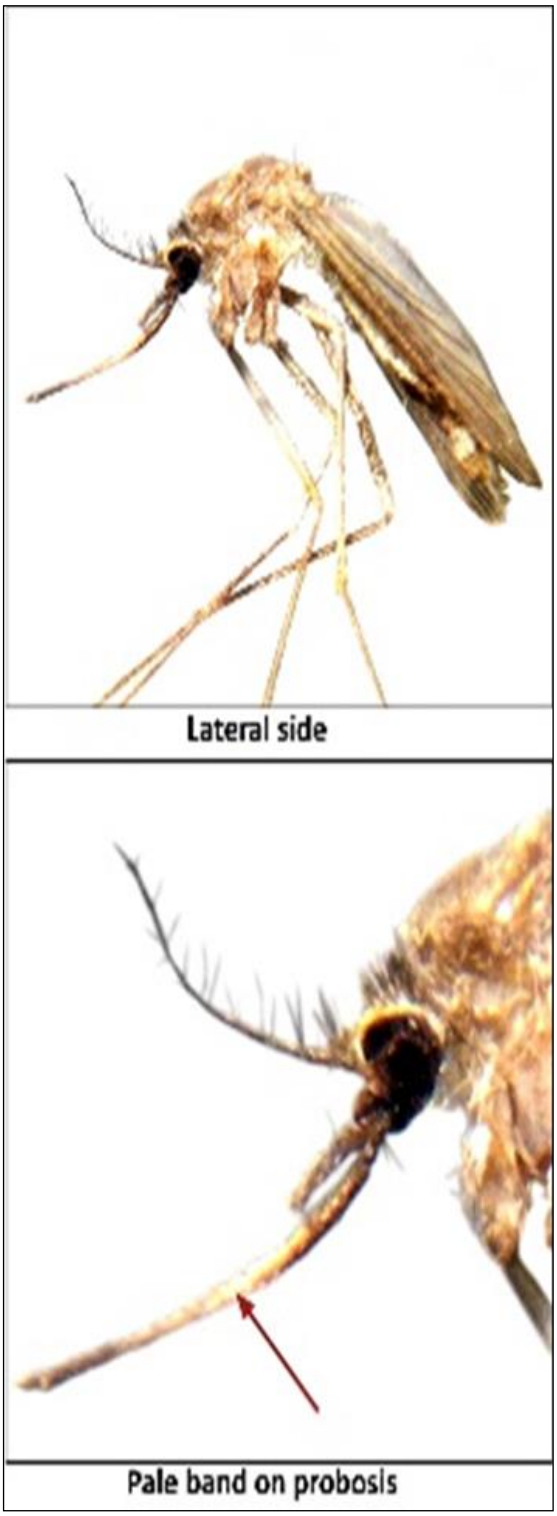

Plate 4: Culex Tritaeniorhynchus

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