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Prevalence and distribution of *Armigeres subalbatus* (Coquillett) in Punjab

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Abstract

Intensive and extensive collection-cum-survey tours were conducted to study, the prevalence and seasonal distribution of *Armigeres subalbatus* (Coquillett) for the first time in the state of Punjab. The results of multiple regression coefficients showed that minimum temperature and humidity are the two main factors responsible for fluctuation in the population density of this species.

Keywords: *Ar. subalbatus*, seasonal prevalence, climatic parameters, Punjab

1. Introduction

Armigeres subalbatus (Coquillett) is a widely distributed species throughout Southeast and East Asia. It is also very common mosquito species found abundantly in Punjab and prevalent throughout the year. *Armigeres subalbatus* have been incriminated in the laboratory as a competent vector of JE virus (Chen *et al.*, 2000) [4]. However, this species has not been incriminated as a vector of human pathogens in India. Larvae are generally found in small collections of water, particularly those containing foul water or water with a high organic content. They can be spotted in hollow logs, rock holes, tree holes, stump holes, bamboo, *Pandanus* axils, sago palm and banana stumps, fruit shells and husks, fallen leaves and spathes, flower bracts, pitcher plants, artificial containers having organic matter and small collections of ground water. Larvae are carnivorous. Adults occur primarily in forested and plantation areas and are mainly active during the daytime and crepuscular periods. The females of a number of species readily attack and viciously bite humans. However, there is little information on the seasonal prevalence of this most abundant species in the state of Punjab. In the present work, seasonal prevalence of *Ar. subalbatus* along with the impact of climatic parameters on its population density has been studied for the first time.

2. Materials and methods

Punjab is located in northwestern India, and has an area of 50,362 km². It is located at the latitude 30° 4' North and longitude 75° 5' east. It is bounded on the west by Pakistan, north by Jammu and Kashmir, northeast by Himachal Pradesh and south by Haryana and Rajasthan. Most of the area of this state comprises of fertile plains, alluvial plain with three rivers and an extensive canal system for irrigation. A belt of undulating Lower Shivalik hills extends along the northeastern part of the state. Punjab is divided into three major regions, i.e. Malwa, Majha and Doaba.

Punjab's climate is characterized by extreme hot and cold conditions. Average annual rainfall ranges between 960 mm in the sub-mountain region and 460 mm in the plains. Punjab has three seasons i.e. summer, monsoon and winter with two transitional periods between winter and summer in March and early April and between monsoon and winter in October and November. During the study period meteorological parameters such as temperature, relative humidity and rainfall were taken in to consideration and procured from the Indian Meteorological Department, Pune.

Adult mosquitoes were collected with the help of oral aspirators and torch light during 06:00 – 09:30 a.m. in morning and 18:00 – 21:30 p.m. in the evening from human dwellings and cattle sheds. Apart from this, catches in outdoor shelters like gardens, nurseries, wild vegetation etc. were also made during day time. Pertinent collection details such as date, locality and source of collection were recorded in the field on field labels. Adults were killed with the help of ethyl acetate vapors and then mounted on a wedge of thick paper supported by entomological

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Pin. Specimens so collected were preserved in collection boxes containing naphthalene balls. The specimens were then brought to the laboratory for further investigations with full care, to avoid any mechanical injury during transport. Standard entomological dipping technique was adopted for the collection of the immature stages from a range of breeding sites like paddy fields, artificial plastic containers, desert coolers, used tyres, mud pots, pitchers, tube-wells, open natural pools, pitfall etc. which provide suitable breeding places for mosquitoes around the year. Immature stages were kept separately in labeled containers and shifted to the laboratory where they were reared for adult emergence. Adult and immature stages were identified using the keys of Barraud (1934) [1], Sirivanakarn (1976) [13], Rattanarithikul (1982) [10] and Reuben *et al.* (1994) [11].

3. Results

A total number of 10, 302 adult representatives of 26 species referable to 13 genera viz., *Aedes* Meigen, *Armigeres* Theobald, *Christophersomyia* Barraud, *Coquillettidia* Dyar, *Culex* Linnaeus, *Fredwardsius* Reinert, *Lutzia* Theobald, *Mansonia* Blanchard, *Mimomyia* Theobald, *Mucidus* Theobald, *Neomelaniconion* Newstead, *Stegomyia* Theobald and *Verrallina* Theobald were collected during the regular collection-cum-survey tours conducted in different districts of Punjab from 2009-2011. The adults of *Armigeres subalbatus* (Coquillett) were found throughout the state of Punjab in good number.

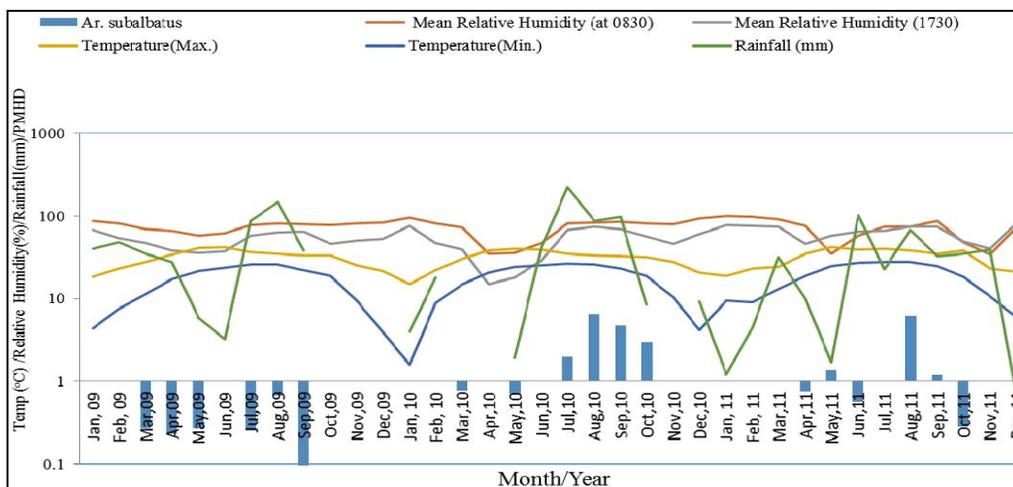
The mosquito populations of above cited species was found to be fluctuating with change in climatic parameters (**Graph 1**). In general, their population showed a negative correlation with all the climatic parameters except minimum temperature (**Table I**). The results of multiple regression coefficients showed that temperature (max.) and humidity (min.) are the two main factors responsible for fluctuation in the population density of this species (**Table II**).

The relationship between populations of *Armigeres subalbatus* (Coquillett) and minimum temperature was more pronounced. Pandian and Chandrashekar (1980) [8] reported that females

of *Armigeres subalbatus* were always found in human habitations and humans acted as good bait throughout the year in Madurai, India. The prevalence was correlated with precipitation (i.e. numbers were high during the wet season and low during the dry season). Kim *et al.* (2009 & 2010) [5, 6] also reported the populations of *Ar. subalbatus* highest during the months of July to August coinciding with rainy season in Republic of Korea. In the present study, the same trend was observed (**Graph 2**). As far as monthly densities are concerned, during the year 2009, the species was encountered in low densities ranging between 0.07- 0.67 per man hour and with a peak in the month of August. Likewise, the densities remained between 0.71 – 6.5 per man hour with peak in the month of August and a similar pattern was also recorded in 2011 because the maximum density noted in month of August i.e.6.23 per man hour (**Graph 3**).

4. Discussion

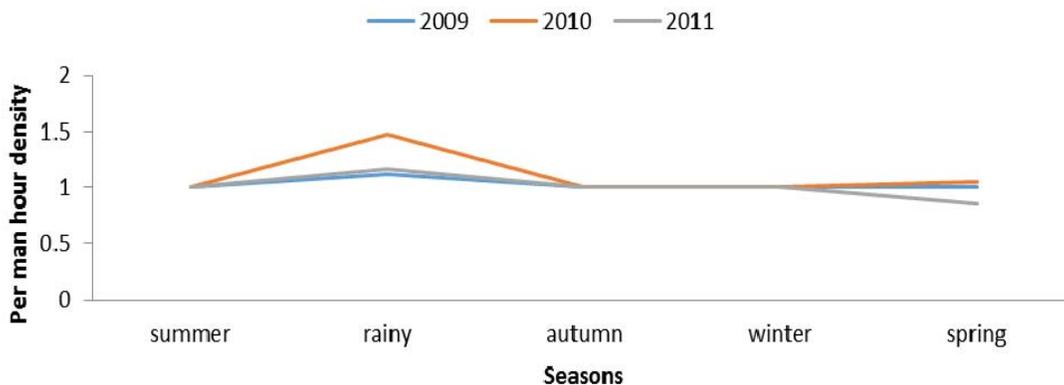
The present species was found to be prevalent in three regions of Punjab i.e. Malwa, Majha and Doaba. However, Kirti & Kaur (1999) [7] reported this species only from the Malwa region of Punjab, which shows that with the changing ecology of Punjab *Ar. subalbatus* has emerged as one of the most abundant mosquito species in the state. The larvae of *subalbatus* were found in artificial containers containing nearly clear to turbid water. It was also observed that *Ar. subalbatus* (Coquillett) start its activity just after dusk (i.e. 17:00 in the evening) and attack humans only inside the jungle/ wild vegetation or outside the houses in mountainous areas. Thus, the species is exophilic in nature. The same observation has been reported by Rudra *et al.*, (2013) [12] in West Bengal. However, the indoor resting of *Ar. subalbatus* was not the dominant mosquito species, matching some other studies (Chandra, 1998; Chandra *et al.*, 2007; Pramanik & Chandra, 2010) [2, 3, 9]. The information from the present study will be instrumental and very useful to the health officials as far as the seasonal distribution and abundance of *Ar. subalbatus*, competent vector of JE virus is concerned.



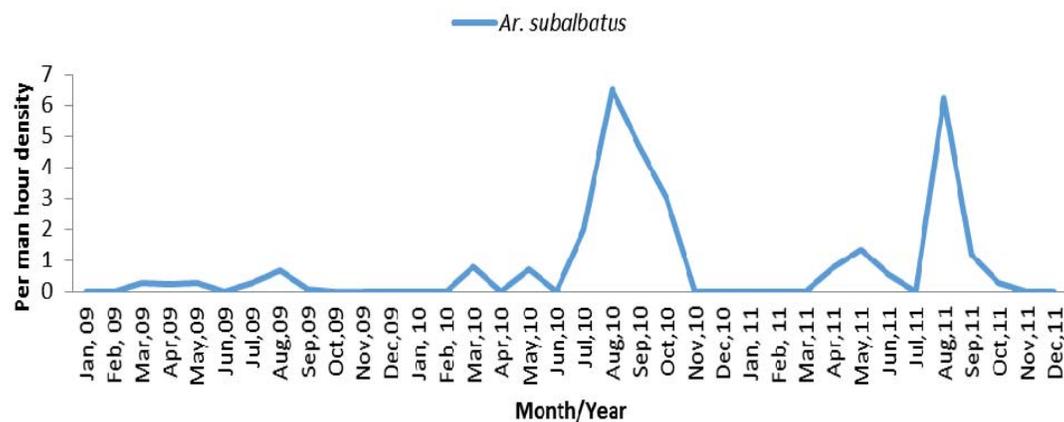
Graph 1: Population dynamics of *Ar. subalbatus* in relation to climatic parameters in Punjab (2009-2011)

Table I: Showing co-relation of per man hour density (PMHD) of *Ar. subalbatus* with different climatic parameters

	Temp. (Max.)	Temp. (Min.)	Humidity (Max.)	Humidity (Min.)	Rainfall
Correlation	-.126	.039	-.134	-.248	-.190
Significance	.492	.831	.464	.171	.299
	33	33	33	33	33



Graph 2: Seasonal density of *Ar. subalbatus* in Punjab (2009-2011)



Graph 3: Monthly variation in population density of *Ar. subalbatus* (2009-2011)

Table II: Showing multiple regression coefficients between per man hour density (PMHD) of *Ar. subalbatus* and different climatic parameters

		Coefficients ^a				
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-0.869	1.123		-.774	.444
	Temperature (Max.)	.055	.035	.258	1.558	.128
2	(Constant)	2.564	1.310		1.958	.059
	Temperature (Max.)	-.204	.074	-.959	-2.748	.010
	Temperature (Min.)	.267	.070	1.329	3.808	.001
3	(Constant)	1.487	2.992		.497	.623
	Temperature (Max.)	-.177	.100	-.835	-1.775	.085
	Temperature (Min.)	.250	.083	1.246	3.036	.005
	Humidity (Max.)	.007	.019	.082	.402	.691
4	(Constant)	.216	3.290		.066	.948
	Temperature (Max.)	-.128	.113	-.603	-1.133	.266
	Temperature (Min.)	.206	.095	1.023	2.155	.039
	Humidity (Max.)	-.002	.021	-.019	-.083	.934
	Humidity (Min.)	.021	.023	.218	.938	.356
5	(Constant)	.356	3.476		.103	.919
	Temperature (Max.)	-.137	.129	-.644	-1.059	.298
	Temperature (Min.)	.216	.119	1.074	1.809	.081
	Humidity (Max.)	-.002	.021	-.021	-.087	.931
	Humidity (Min.)	.021	.023	.218	.922	.364
	Rainfall	-.001	.007	-.030	-.147	.884
a. Dependent Variable: PMHD of <i>Ar. subalbatus</i>						

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