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Adult Density of *Culex quinquefasciatus* Say, Filarial Vector in Thapa Gaun, Jhaukhel and Lama Tole, Nagarkot VDC, Bhaktapur District

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Abstract

A six month long entomological study on the adult density of *Culex quinquefasciatus* Say, the principal vector of filariasis was conducted during April to September 2011 at Thapa Gaun, Jhaukhel and Lama Tole, Nagarkot VDCs of Bhaktapur district. The study resulted 916 (882 female and 34 male) *C. quinquefasciatus* out of the total collected mosquitoes (3040). The population density was found to be highest in Thapa Gaun (26.09) while indoor density was relatively higher than the outdoor density for both the sites which were significantly related. Monthwise densities were insignificantly related with July showing the highest density while the density in human residence and cattle shed were insignificantly related for Jhaukhel site and was significantly related with Nagarkot site. Morning and evening population densities were significantly related for both sites while no significant relationship was observed between the density of the vector and temperature and variation in temperature and humidity in the study area.

Key words: lymphatic filariasis, indoor density, outdoor density, morning density, evening density

Introduction

Lymphatic filariasis (LF) is a major cause of acute and chronic morbidity among humans causing socio economic problems in the tropical and sub-tropical areas of Asia, Africa, the Western Pacific and some parts of the Americas with an increasing prevalence worldwide (WHO 1992, Sunish *et al.* 2007). The uncontrolled population growth, particularly in developing countries of Asia, Africa and Latin America has caused the deterioration of the ecology and environment. This factor has also causes the fluctuations in the magnitude of LF and other vector borne diseases (Dhanda *et al.* 1996).

Globally, the majority of LF caused by *W. bancrofti* is transmitted by *C. quinquefasciatus* Say (Curtis). It is regarded as an urban disease and *C. quinquefasciatus* is recognized as urban mosquito with ubiquitous breeding sites having close association with man. In Nepal, *C. quinquefasciatus* is the principal vector of bancroftial filariasis (Darsie & Pradhan 1990). Nepal lies within the endemic zone of LF. Out of the total population, (approximately 23.2 million), 13.9 million (60%) are estimated to be at the risk of filarial infection (Jung 1973). Sherchand *et al.* (2003) have reported the disease to be endemic in 33 districts including Bhaktapur. Epidemiological studies on this disease were carried out in Nepal by various people (Pradhan *et al.* 1997, Brito *et al.*1998, Manandhar 2001, Ghimire *et al.* 2002, Sherchan *et al.* 2003, Mahanta *et al.* 2006).

Temporal and seasonal fluctuation of population densities of *C. quinquefasciatus* have been studied

extensively in many parts of the world (Jayasekera *et al.* 1991, Gowda & Vijayan 1992, Ramaiah and Das 1992, Gowda and Vijayan1993, De and Chandra 1994, Sabatinelli *et al.* 1994, Pipitgool *et al.* 1998, Dixit *et al.* 2002, Murty *et al*. 2002, Dixit *et al.* 2009, Kaliwal *et al.* 2010, Rosângela and Lêda 2011).The distribution of this vector has been reported from different parts of Nepal including Bagmati, Koshi and Narayani zones (Peters & Dewar 1956) and also from Chitwan district (Neupane *et al.* 2009, 2011).

Existence of *C. quinquefasciatus* in Bhaktapur district has been shown by a Tamrakar in 2009 while studying the seasonal distribution of *C. tritaeniorhynchus*, the vector of Japanese encephalitis in Kathmandu valley. Till date no detail study on the population density of this vector has been attempted. Hence this present study was carried out in two different localities of Bhaktapur district so as to obtain the baseline data on the population density as a preliminary step for developing a control strategy to eliminate lymphatic filariasis from Nepal. Nevertheless the one year detail study was essential to confirm the real situation of the vector, the present study may fulfill the requirements to some extent.

Methodology

Study area

Two sites Thapa Gaun of Jhaukhel VDC and Lama Tole of Nagarkot VDC were selected for this study and the sites were selected on the basis of atitudinal variation. Thapa Gaun of Jhaukhel VDC located at latitude of 24°41'32''N and a longitude of 85° 25'50''E is situated at an altitude of 1314m above the mean sea level while Lama Tole of Nagarkot VDC is located at an altitude of 1669m above the mean sea level with a latitude of 27°42.725'and a longitude of 85°29.703'.

House structure

Both sites comprise the human dwellings made by bricks with mud and the roof made by zinc and hedge. Few cemented houses were also observed in Thapa Gaun which were absent in Lama Tole. The kitchen was built at the ground floor and was of traditional type with a smoky stove. Also use of smoke and mosquito coil was observed. Bushy vegetation, stagnant water, outdoor resting places for cattle and accumulated kitchen and vegetable waste along with cattle dung were observed in the front and behind the houses which were the perfect breeding sites for the mosquitoes.

Cattle shed

Majority of the cattle sheds were made up of wooden blocks with hedge roof (open type) and also by brick with wooden blocks with zinc roof (closed type).

Entomological surveys

The collection of indoor resting mosquitoes was done from Jhaukhel and Nagarkot VDC using aspirator tubes and torchlight. Households were surveyed in sequence along the block from the starting house between 7:00 PM to 9:30 PM from 7:00 PM to 9:30 PM and 7:00 AM to 9:30 AM at monthly interval. Prior to the survey, permission was taken from each household for collection. Fifteen minutes were spent in each catching station (human dwelling and cattle sheds) to collect the mosquitoes resting on different surfaces *viz.*, walls, hanging objects (clothes, bags, wires, umbrellas, baskets *etc.*), objects on the floor (cots, tables, chairs, benches *etc.*) and horizontal surfaces (shelves, wooden planks, ceiling, *etc*) for collecting the mosquitoes resting inside the households and cattle sheds, while 30 minutes were spent by each collector for the outdoor collection on outside walls, vegetation and bushes around cattle sheds and around outdoor stored materials etc for two hours by 4 collectors. Altogether, four man hours were spent searching mosquitoes in and around 16 houses of four locations by mosquito collectors.

Unoccupied houses, offices, and schools were not sampled. Prior to continuing surveys of unsampled households, an attempt was made to inspect houses that were previously closed. This process was carried out until all the houses in each neighborhood had been surveyed or repeated attempts to gain access failed. All the mosquitoes were also recorded and transported in the laboratory for identifing them properly using the standard identification keys (Darsie & Pradhan 1990). SPSS 16.0 version was used for the statistical analysis of the compiled data.

Results and Discussion

A total of 3040 mosquitoes (1621 from Thapa Gaun and 1419 from Lama Tole) were collected from a six month entomological study in Thapa Gaun and Lama Tole. The highest number of mosquitoes (1621) were obtained from Thapa Gaun, Jhaukhel contributing 53.32 per cent to the total collection in compared to Lama Tole, Nagarkot (44.21%).

As shown in Fig 1 and 2, outdoor collection of mosquitoes was found to be less in number as compared to indoor collection. The highest number of *C. quinquefasciatus* was collected in Thapa Gaun of Jhaukhel VDC (indoor 441 and outdoor 70) while the least number was collected in Lama Tole of Nagarkot VDC. In July, both study areas showed highest indoor and outdoor collections of *C. quinquefasciatus*. After July, the population showed declining trend from August and reached the lowest prevalence in September. In indoor collection, cattlesheds of Thapa Gaun of Jhaukhel VDC showed the highest value (362). Also the same site showed the highest outdoor collection.

Table 1. Number of mosquitoes collected from Jhaukhel and Nagarkot VDC

S.N.	Month	Thapa Gaun, Jhaukhel		Lama Tole, Nagarkot	
		Total number of mosquitoes (%)	**Total number of *Culex quinquefasciatus* (%)**	**Total number of mosquitoes (%)**	**Total number of *Culex quinquefasciatus* (%)**
1	April	6 (0.37)	2 (0.004)	-	-
2	May	236 (14.56)	148 (28.96)	47 (3.31)	15 (3.70)
3	June	512 (31.58)	133 (26.03)	216 (15.22)	61 (15.06)
4	July	566 (34.92)	189 (36.98)	687 (48.41)	313 (77.28)
5	August	159 (9.81)	36 (7.5)	246 (17.37)	12 (2.96)
6	September	142 (8.76)	3 (0.59)	223 (15.72)	4 (1.00)
	Total	**1621 (53.32)**	**511(55.79)**	**1419(46.68)**	**405(44.21)**

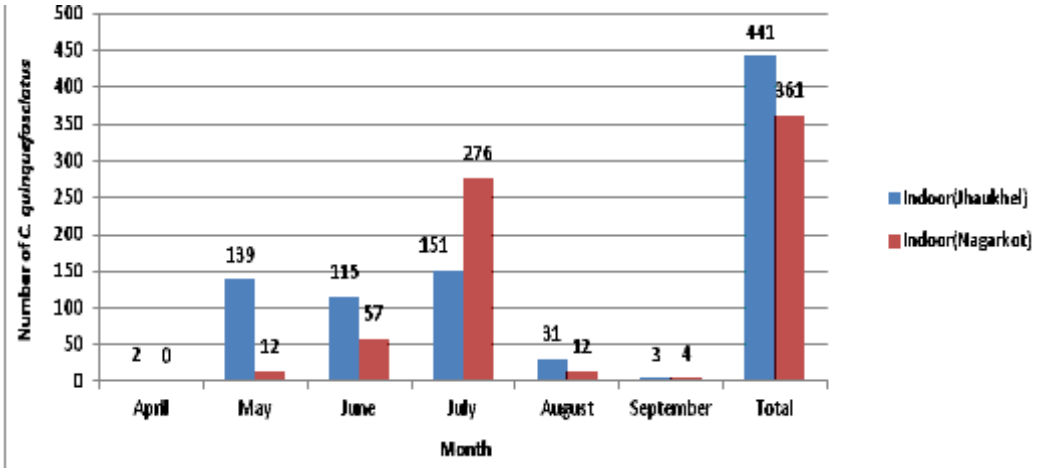

Fig. 1. Total number of indoor *C. quinquefasciatus in both study sites*

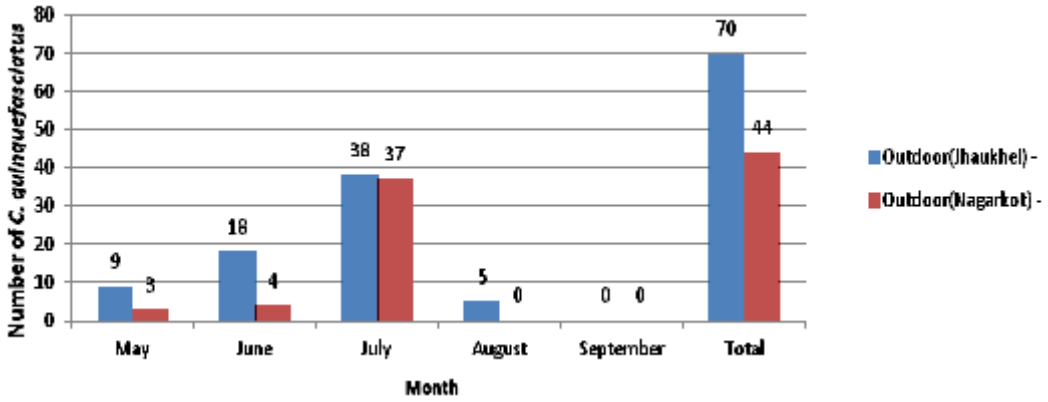

Fig. 2. Total number of outdoor *C. quinquefasciatus* in both study sites

As shown in figure 3, females *C. quinquefasciatus* were found relatively higher in number (882) as compared to males (34), out of which Jhaukhel collection comprised of 489 females and 22 males. Whereas, Nagarkot collection comprised of 393 female and 12 males *C. quinquefasciatus*. The highest number of females were observed in July (502) followed by June (173) and May (153) and the least number was observed in April (2). The number of male mosquitoes were found to be highest in June (21). Not even a single male *C. quinquefasciatus* was obtained in the month of April, July and September.

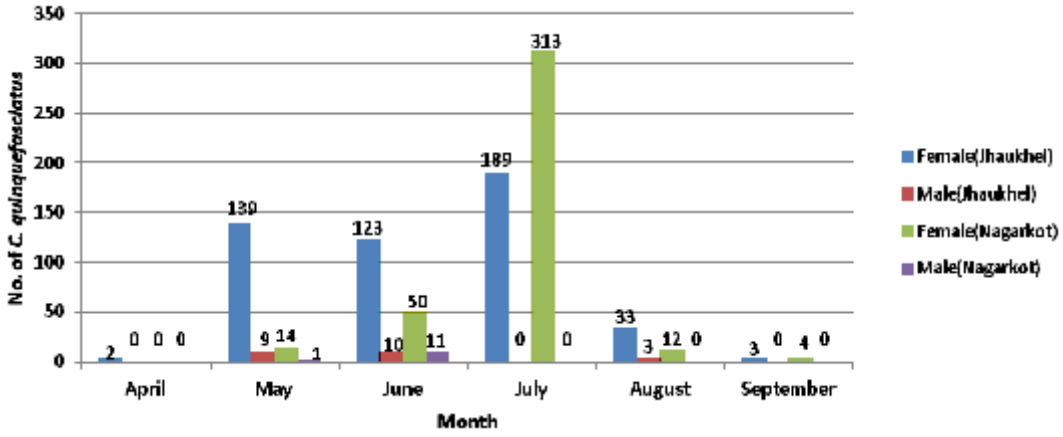

Fig. 3. Sexwise frequency of *C. quinquefasciatus*

The seasonal distribution of *C. quinquefasciatus* (Fig. 4, 5 & 6) showed highest seasonal prevalence in Thapa Gaun (42.60) than in Lama Tole (33.76). Indoor density showed highest number in Jhaukhel (54.14) than in Nagarkot (44.63). Also for the outdoor density Jhaukhel showed the highest number (17.5) and least was in Nagarkot (11). Monthwise variation showed the highest population density during July for both sites, Jhaukhel (15.75) and Nagarkot (26.09). Both of these sites showed significant correlation between outdoor and indoor densities (0.01 level, 2-tailed). Monthwise densities for both sites were found to be insignificantly related while it was insignificant for the relation between density in human residence and cattleshed for Jhaukhel site and significant for Nagarkot site (0.01 level, 2-tailed).

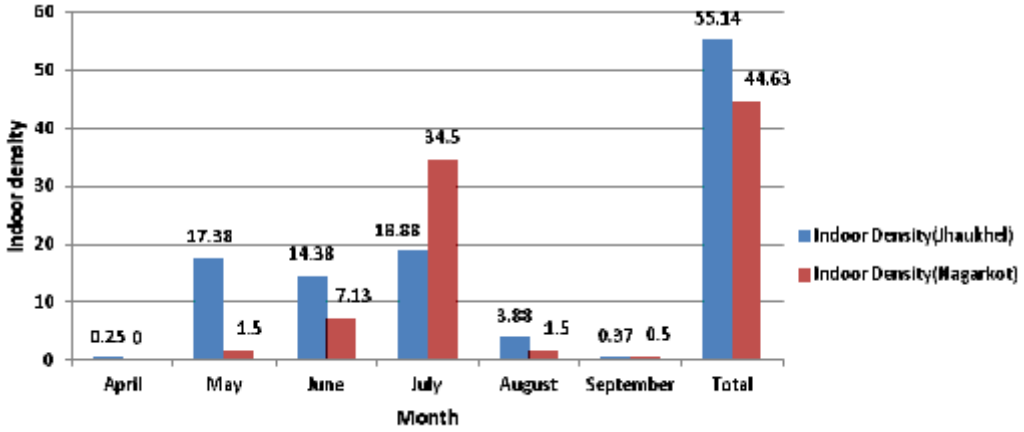

Fig. 4. Indoor density of *C. quinquefasciatus*

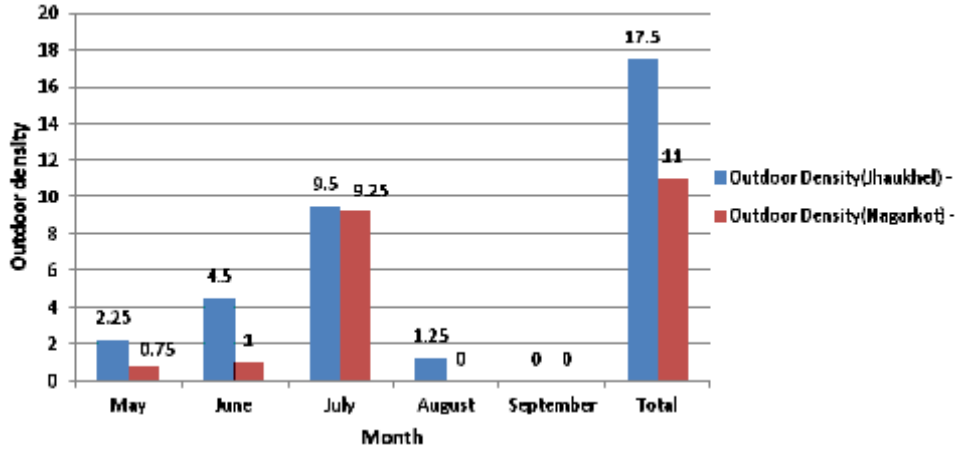

Fig. 5. Outdoor density of *C. quinquefasciatus*

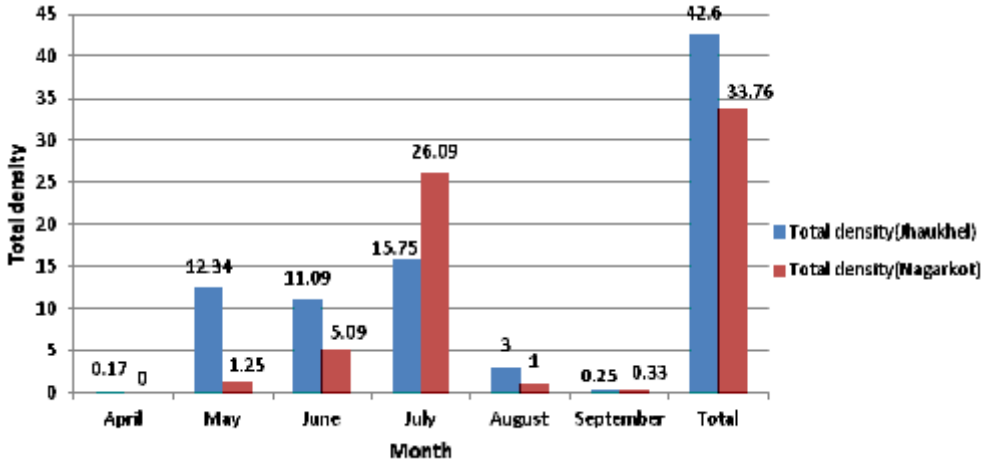

Fig. 6. Total density of *C. quinquefasciatus*

The morning and evening population densities at Jhaukhel and Nagarkot showed the maximum density during morning hour (55) than in the evening hour (26.67). Similar type of the result were observed in Lama Tole of Nagarkot VDC with higher density (33.67) in the morning and lower density (33.34) in the evening. Similarly, the peak density (25.17) observed in the morning hour in July at Lama Tole of Nagarkot (Fig. 8). Significant correlation was found between morning and evening population densities of *C. quinquefasciatus* for both of the study sites (0.05 level, 2-tailed).

Figures 8 and 9 show the association of density with temperature and relative humidity. In Jhaukhel, the highest and lowest temperature were recorded in the month of July (26.15°c) and April (16.95°c) respectively. While for Nagarkot the highest and lowest temperatures recorded were 24.63°C in July and 18.73°c in April respectively.

In Nagarkot, the highest and lowest relative humidity were observed in the month of August (89.75%) and lowest in April (65.75%). Whereas, in Lama Tole of Nagarkot VDC the highest and the lowest humidity were observed in July (89%) and April (65.75%). Statistically, density of *C. quinquefasciatus* was not found to be significantly associated with temperature and relative humidity.

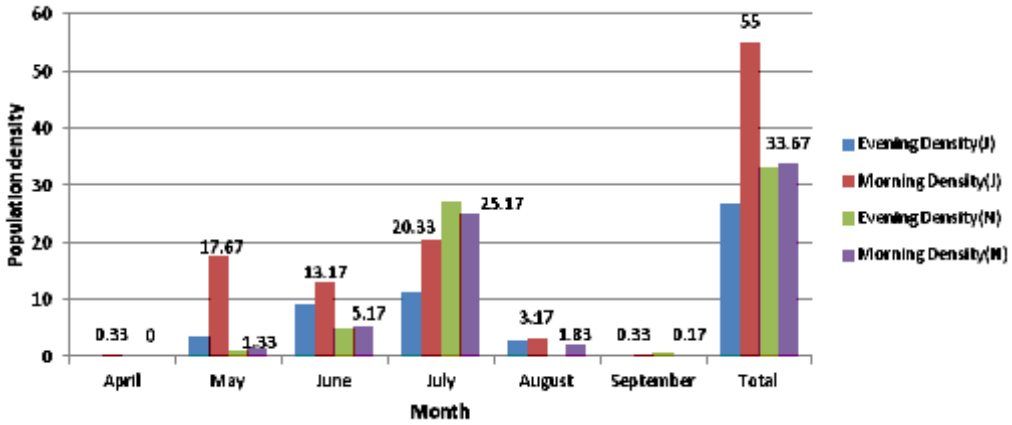

Fig. 7. Morning and evening population density of *C. quinquefasciatus*

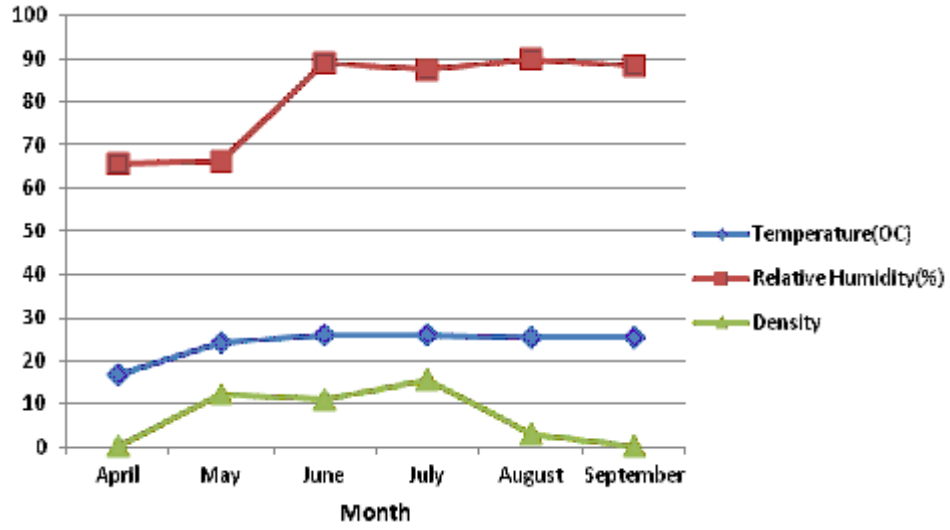

Fig. 8. Association of density of *C. quinquefasciatus* with temperature and humidity of Thapa Gaun of Jhaukhel VDC

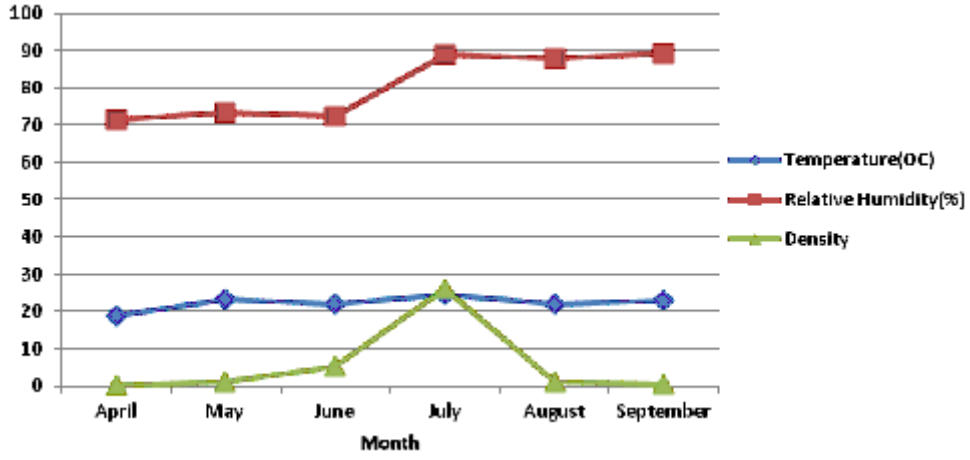

Fig. 9. Association of density of *C. quinquefasciatus* with temperature and humidity at Lama Tole of Nagarkot VDC

In the present study, the highest population density of *C. quinquefasciatus* was recorded in Lama Tole, Nagarkot VDC(26.09) during July while both the selected sites viz. Thapa Gaun of Jhaukhel VDC and Lama Tole of Nagarkot VDCs showed highest per man hour density (PMHD) which can be compared with a study performed by performed by Kaliwal *et al.* (2010) which reported perennial prevalence of *C. quinquefasciatus* with a very highest per man hour density in February (48.6) and lowest in September (6.6). The present study showed the highest per man hour density during July in Lama Tole Nagarkot (26.09) and lowest (0) in the same place in April. A similar type of the study carried out by De and Chandra (1994) found out considerably high average man hour density of *C. quinquefasciatus* (31.10). Dixit *et al.* (2002) found the highest density of *C. quinquefasciatus* in March (44.29) and the lowest in November (16.64). Neupane (2009) found that *C. quinquefasciatus* was the most dominant species in Chitwan and September was the most favorable month for the distribution of this species.

In this study, the monthwise variation of densities of the vector was observed to be insignificant. Also the association of vector population density was insignificantly associated with the months. Highest density during the month of June may be due to increased temperature, pre monsoon showers in April- May months and the onset of monsoon rains in the month of June in Bhaktapur while the sudden decline in August can be attributed to flushing of drains, flooding of outdoor breeding sites and heavy mortalities caused due to physical impact of heavy rains (Kaliwal *et al.* 2010).

Predominance of female *C. quinquefasciatus* over male was observed to be higher in the study sites which was similar to the study performed by Kaliwal *et al.* (2010) in India. The present results are similar to earlier observations made in Arthala (Kaul *et al.* 1968) and Rajhamindary (Dhar *et al.* 1968). Less proportion of male in indoor resting collection may be due to their exophagic and exophilic behavior (Laporta *et al.* 2006) and their lower life expectancy (Kaul *et al.* 1968). The same reason might be true for the present study to explain the higher indoor density of *C. quinquefasciatus* in selected areas than the outdoor density.

Relations of seasons, different climatic factors like temperature, humidity and rainfall on the prevalence of vector have been previously studied (Kaul 1984, Pipitgool *et al.* 1998, Dixit 2009, Kaliwal *et al.* 2010). Unlike the present study which showed insignificant correlation between population density of *C. quinquefasciatus* with temperature and relative humidity, a study carried out in Chitwan district showed the positive correlation of *C. quinquefasciatus* density with temperature (Neupane *et al.* 2009, 2011).

In the present study highest indoor densities were observed in both VDCs. The density was reported to be higher in cattle than in human residences which might be due to the smoky kitchen located at the ground floor and also the use of mosquito coil. The density in cattleshed was found to be highest in comparision to human and the highest was reported from Jhaukhel. Wheareas, the highest density in human was reported from Nagarkot. The outdoor density was highest n Jhaukhel and the same place also showed the highest resting density. The outdoor density is less than the indoor density. Association between indoor density and outdoor density were found to be statistically significant while vector density for human residence and cattleshed was significant for Nagarkot site and insignificant for Jhaukhel site. The results obtained in this study are similar to a study by Neupane *et al.* (2009) which showed the highest indoor density from Kholesimal and lowest from Champanagar village of Chitwan district. The maximum room density of *C. quinquefasciatus* (6.5) was recorded from Champanagar in post monsoon and also the indoor density in human was reported to be highest in comparision to cattle. Indoor density was found to be significantly associated with outdoor density in present study while the resting density was insignificantly associated with month for both the study sites. Jhaukhel site showed highest resting density in May showing the peak value (7.73) than Nagarkot site (12.74) which showed the peak value in June (7.01). The peak value of resting density might be explained on the basis of indoor resting preference of vector mosquito rather than the outdoor areas. The collection time was also the peak hour for the vector to move in to the human or cattle settlement for blood feeding.

Though the existence of the vector of *Wuchereria bancrofti* was already known from Bhaktapur, the population density of the selected sites has not been previously studied which is one of the preliminary requirements for the implementation of control measures for vector and vector borne diseases. Thus, this study concluded that the month of July is the most prominent time for the breeding and growing of the vector mosquitoes. In the light of the present findings, the integrated vector management involving personal protective measures, elimination of breeding sources and adequate anti-larval operation can bring down the density of vectors and also prevent the active transmission of filariasis. The present study was conducted only in two localities of Bhaktapur district for 6 months. It may fulfill the requirement to some extent but a detail one year study including more places is needed to confirm the real situation of the vectors in Bhaktapur district which might be a step for developing a control strategy to eliminate lymphatic filariasis from Nepal.

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