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Distribution, Seasonality and Relative Abundance of Stomoxys Flies in Selected Districts of Central Ethiopia

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Abstract: A longitudinal study design was employed to collect *Stomoxys* flies between January, 2010 and December, 2011 from three different agro ecological settings, Sebeta, Debre Zeit and Fentale Districts, Ethiopia using vavoua traps. The study on the trapped *Stomoxys* flies was carried out with the aims of identification of *Stomoxys* species and comparison of the distribution, seasonality and relative abundance of *Stomoxys* flies in different seasons of the year among the three Districts of central Ethiopia. Final identification of *Stomoxys* and species assignment was done using a stereomicroscope in acarology and helminthology laboratory of National Animal Health Diagnostic and Investigation Centre, Sebeta, Ethiopia. The *Stomoxys* fly species that were identified and proved to exist in Ethiopia were *S. calcitrans*, *S. niger, S. sitiens, S. taeniatus, S. inornatus and S. ochrosoma,*. Among the species that were identified in our study, *S. calcitrans* was proved to be the most abundant fly in all agro-climate locations. Statistical analysis of the data proved the presence of statistically significant difference ($p<0.05$) in the population density of *Stomoxys* among the study sites. *Stomoxys* flies were found to be more abundant during the long rainy season with pick density in the months of September and August. This study indicated that *Stomoxys* flies were known to be distributed at immense level in the study areas and could cause high production losses by annoyance of grazing and they could serve as mechanical vectors of diseases in livestock. Therefore, attention towards best control and prevention methods of *Stomoxys* flies is essential to mitigate the economic losses in the livestock industry.

Key words: Distribution · Seasonality · Relative abundance · Stomoxys flies · Central Ethiopia

INTRODUCTION

The genus *Stomoxys* contains about 18 recognized species. Among them 17 have a tropical distribution and *Stomoxys calcitrans* known as stable fly is the most important and cosmopolitan species [1]. *Stomoxys* flies are economically important pests of cattle. Both males and females are blood sucking flies that attack domestic, wild animals and sometimes human beings across the world [2].

The *Stomoxys* flies are as large as musca domestica and they are also called the biting house flies because of their morphology, color and their living habitat associated with human and livestock. These pests of cattle cause notable economic losses and several studies have attempted to estimate their economic impact on cattle production [3]. The period in which *Stomoxys* flies mostly occurs in abundant in Ethiopia are from August to September, the end of long rainy season [4].

High level density of *Stomoxys* flies can lead to significant reductions in weight gains of livestock through decreasing feed intake; reduce vital pasturing time and milk production. The most source of annoyance to livestock is through deep biting of the fly while feeding by its long proboscis and injury formation of various sizes when the animals react to mass attacks of the flies [5].

The high number of biting fly population may have a direct influence on the epidemiology of communicable diseases to animals. For example *Stomoxys* flies have been implicated as mechanical vectors of anaplasmosis,

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trypanosomosis, bacterial diseases and viral diseases in animals. To alleviate these potential vector populations, reduce their pathogenic and economic impacts, control measures should therefore be directed toward destroying breeding places and applying insecticides as well is better [6].

In spite of the aforementioned prevailing situation and the presence of a number of animal diseases which could be transmitted by the fly in Ethiopia, there is paucity of well documented information on the distribution of *Stomoxys* fly species and their population density. Therefore, the study on the trapped *Stomoxys* flies was carried out with the aims of identification of *Stomoxys* species and comparison of the distribution, seasonality and relative abundance of *Stomoxys* flies in different seasons of the year among the three Districts of central Ethiopia.

MATERIALS AND METHODS

Description of the Study Area: The study was conducted in three selected Districtsof central Ethiopia namely Sebeta, Debre Zeit and Fentale which represent three agro climate Zones highland, midland and lowland, respectively. The specific locations of the study in the Districts were around Sebeta town, Ude kebele and around Metehra town respectively.

Sebeta is located 25 km Southwest of Addis Ababa and situated at a latitude and longitude of 8°55'N and 38°37'E, respectively. It has an elevation of 2356 m above sea level and has annual rainfall of about 1650 mm. The mean annual minimum and maximum temperature is 8°C and 19°C, respectively. Its farming system is a mixed crop-livestock production system where draft-oxen are used for ploughing to produce crops and manure is the cheapest and easily available fertilizer to increase soil fertility.

Ude kebele is found in Debre Zeit and located about 60 km, South-East of Addis Ababa and it is located at 8.40'454'' North and 39.02'165''East. It has an elevation of 1885 m above sea level; its annual average minimum and maximum temperature ranges from 8.9°C and 28.3°C respectively. Its farming system is also mixed crop-livestock production system where most livestock and agricultural activities are concentrated.

Metehara is the capital town of Fentale district and is situated at 08° 52' 727'' N latitude and 039°55'028''E longitude. It has an annual temperature ranging from 25°C-40°C. Its elevation is about 910 m above sea level. The climatic condition is semi arid lowland (kola) with low and erratic annual rain fall. It has two rainy seasons in the year. The major rainy season occurs from July to mid of September. The second minor rain is expected to rain from March to April. The average annual rainfall ranges from550-760 mm which is not enough for long season crop type's production. The dry season runs from October to February. The farming system is agro-pastoral mainly depending on livestock production for their livelihood [7].

Fig. 1: Modified vavoua trap employed for *Stomoxys* flies trapping

Study Methodology: A longitudinal study was carried out between January, 2010 and December, 2011 to jam *Stomoxys* flies for identification of *Stomoxys* species and comparison of the temporal fly population density in different seasons of the year among the three Districts, Vavoua trap with adapted collecting cone was used to catch *Stomoxys* flies (Figure 1).

The blue and black color of the trap was reported to catch *Stomoxys* flies effectively [8]. The poles were greased to prevent ants climbing the poles to prey trapped flies. Cow urine and acetone was mixed and put under the pole to attract flies.

Flies were collected once from the trap in 24 hours and deployed for three consecutive days every month across the year. The flies were killed by 70 % ethanol alcohol, their number counted and recorded and preserved in universal bottle using 70% ethanol alcohol for further species identification in the laboratory. Then the bottles were labeled with the site of collection, date of collection, trap number, types of fly's captured. Flies were mounted on a stereomicroscope and systemic species identification method based on morphological characteristics was done at the National Animal Health Diagnostic and Investigation Centre, Sebeta, Ethiopia. Species of *Stomoxys* flies were identified using morphological identification key developed by Zumpt [1].

After identification of the samples at the species level, flies were again preserved in a 70% ethanol alcohol for further reference of the samples. The data record of species identification was entered in to the Excel spread sheet for statistical analysis.

Data Management and Analysis: Agro ecological and temporal variation of identified fly species, population density and environmental conditions were the variables for the study. The interaction between the number of *Stomoxys* fly captured and the seasonal rainfall in the months of the year in each agro climate was described. The Pearsons chi-square (χ^2) test at a significance level of 5% and 95% CI was used to compare the *Stomoxys* fly population density among the three agro-climate Zones. The difference among factors was statistically significant if the p-value was less than 0.05 ($P<0.05$). Simple excel model was used to summarize the data in graphs and for $\chi 2$ homogeneity test.

RESULTS

Species Identification: An average fly catch per trap in a day (fly/trap/day) was calculated for each month across all agro climates. Six *Stomoxys* species, *S. calcitrans* (Linnaeus), *S. sitiens (*Rondani), *S. niger (*Macquart), *S. ochrosoma* (Speiser), *S. inornatus (*Grünberg) *and S. taeniatus (*Bigot) were identified and proved to exist in Ethiopia.

High fly population density starts to build up from the month of June and the peak populations were confirmed to occur in August and September which was a mirror reflection with the long rainy season in all agro climate Zones. There was also slight increase in fly population density in February when the relative moisture raised in this month (Table 1).

Table 1: *Stomoxys* flies collected between January, 2010 and December, 2011

Months	High land (Sebeta)	Mid land (Debre Zeit)	Low land (Fentele)
January	17	11	85
February	16	60	107
March	3	1	1
April	10	2	2
May	16	2	1
June	92*	139 *	3
July	294	260	54 *
Aug	1056	1582	1166
Sep	1160¤	1702 ¤	429 ¤
October	332	136 #	196 #
November	261	102	227
December	56	7	65

* The regular rain of the season started to rain in the mid-June.
¤ The Rain stopped
Unseasonal rain affected the fly catch

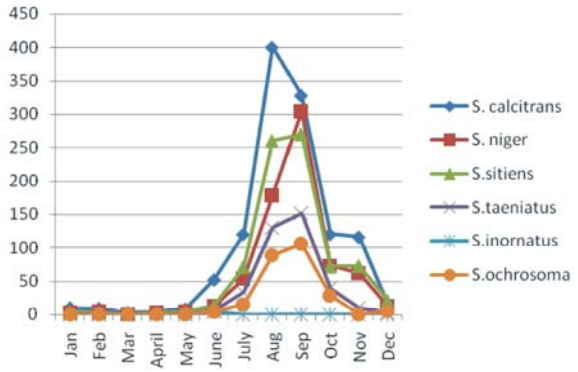

Fig. 2: *Stomoxys* fly species catch per trap per day (FTD) across the months of the year in highland agro climate zone (Sebeta District)

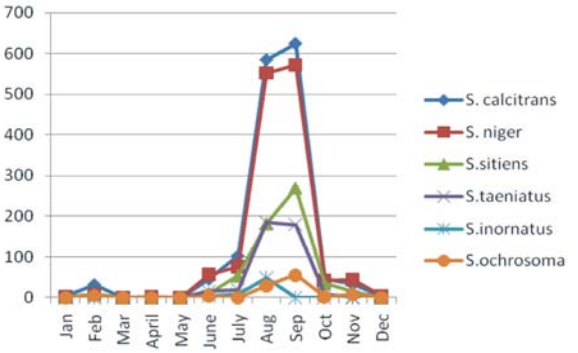

Fig. 3: *Stomoxys* species catch per trap per day (FTD) across the months of the year in Midland agro climate Zone (Debre Zeit District)

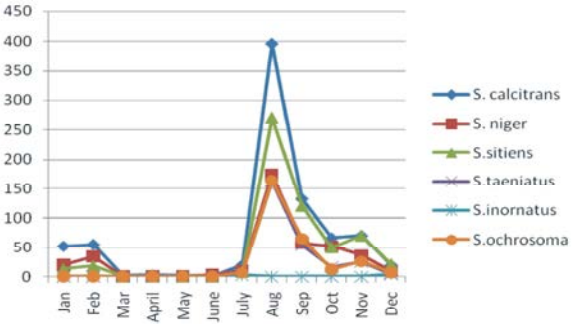

Fig. 4: *Stomoxys* species catch per trap per day (FTD) across the months of the year in Lowland agro-climate zone (Fentale district)

Distribution of *Stomoxys* Species among Agro Climates: Comparison of fly trap per day (FTD) in terms of the density occurrence of various species using homogeneity χ^2 test performed separately for each agro-climate showed that there was significant difference ($p < 0.05$) in the population density of different species. Among the species, *S. calcitrans* was the most abundant in all agro-climate locations. The population density of *S. niger* and

S. sitiens were higher following the *S. calcitrans* in midland and highland agro climates descending order (Figure 2).

In highland zone the occurrence of *S. inornatus* was almost insignificant in number. But it was slightly high in midland than in both highland and lowland agro climate Zones (Figure 3).

The population density of *S. ochrosoma* was particularly higher in lowland agro climate, followed by in the highland as compared with its occurrence in midland agro climate Zone. Moreover, the population density of *S. sitiens* was exceptionally high in lowland zone next to *S. calcitrans* (Figure 4).

DISCUSSION

The species assignment of the *Stomoxys* flies in our study indicated the occurrence of six *Stomoxys* species namely *S. calcitrans*, *S. sitiens*, *S. niger, S. ochrosoma, S. inornatus and S. taeniatus* in Ethiopia. All the six species of stable fly were jammed in all three agro ecological Zones. The occurrence of S. *calcitrans, S. sitiens, S. taeniatus and S. niger* was reported by Sinshaw *et al*. [9] in his research conducted in three districts bordering Lake Tana of Ethiopia. Kigaye and Jiffar [10] in a survey of ectoparasite of cattle in Harar and Dire Dawa Districts, South Eastern part of Ethiopia reported the presence of 6 species of stable flies *S. calcitrans*, *S. sitiens*, *S. niger*, S. varipes, S.bilineata and S. brunnipes. Hence these *Stomoxys* species were known to circulate and occur in the country imposing sever economic loss.

Among the *Stomoxys* fly species trapped, *S. calcitrans* was confirmed to be the most abundant in all agro climate locations followed to *S. niger*. The identification result of our research was not in line with Ahmed *et al.* [11] who reported similar relative abundance of *S. calcitans* and *S. niger* in his research conducted in Southern Kaduna, Nigeria. The differences in the findings between these studies could be attributed to the differences in the epidemiology of the study areas and the differences in the study period.

Among the *Stomoxys* fly species trapped *S. sitiens* was confirmed to exist in Ethiopia and this finding agrees with Masmeatathip *et al*. [2] who reports *S.* sitiens, from Ethiopia, Gambia, South Africa and Egypt.

The population density of *S. ochrosoma* was particularly higher in lowland agro climate, followed by the highland as compared with its occurrence in midland agro climate Zone. Also the population density of *S. sitiens* was exceptionally high in lowland zone next to *S. calcitrans.*

In low land area particularly in Metehra and mid land the populations of livestock are high in number so that *Stomoxys* flies could be increased their number. The reason could be the consequence of the relatively high host density for blood-feeding adults and temperature to maintain acceptable breeding habitats.

In this study high numbers of *Stomoxys* flies, in particular *S. calcitrans* were collected in rainy seasons in three agro climates specially August and September. This finding agrees with Masmeatathip *et al*. [2] and Vithee *et al.* [12] who reported high fly population density was found during the rainy seasons and end of September. This may be due to presence of the rainfall that serves for rapid breeding of flies.

Gari, *et al.* [4] also reported that high fly population density starts to build up from the month of June and the peak populations were in the months of August and September with the long rainy season in Ethiopia. The reason for high fly population density of flies in the rainy seasons is that rainfall is one factor responsible for breeding of these flies thus flies lay their eggs during rainy season, hatch their egg and finally increase their number.

The current research was in line with Ahmed *et al*. [11] who stated that population density of *Stomoxys* flies increased at the beginning of the rains (April-June), attaining a peak in the mid wet season (July-September) and declined in late wet season (October) in his research conducted in Southern Kaduna, Nigeria. This fluctuation in population of the fly in dry season and spring is due to unseasonal rain that affects the fly catch.

The probable reason for the relatively high numbers of stable flies, *S. calcitrans* in particular among study sites could be the high host density for blood feeding adults and suitable soil and environmental conditions for stable fly larvae to complete their life cycle. In addition, the mixture of manure with decaying materials or silage appeared to be a highly favorable medium for developing stable fly larvae.

Relatively low amount of *Stomoxys* flies were caught in low land area (Fentale District) when compared with high land and midland. The reason could be due to the low amount of rainfall for breeding flies. But there was slight increase in fly population density in February when the relative moisture raised in this month and due to the regular short rainy season started earlier and left out very short resulting in prolonged short dry season in this year.

CONCLUSION

Stomoxys flies were proved to be widely distributed in Sebeta, Debreziet and Fentale districts. These flies were confirmed to be evident throughout the year with some variations among the different seasons in their rate of distribution and density with the highest fly dynamics during the rainy seasons. The presence of high density of *Stomoxys* poses a health risk and rise concerns about the protection of animals in the study areas. In addition, there is a need to implement strict fly control to minimize or eliminate the risk of animal disease which could be carried by these flies. To the best of our knowledge, this is the first report on the occurrence of *Stomoxys* species in the study areas. The results warrant further investigations to elucidate the animal health significance in the area.

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