

FIRST SURVEY OF SEASONAL ABUNDANCE AND DAILY ACTIVITY OF *Stomoxys* spp. (DIPTERA: MUSCIDAE) IN KAMPHAENGAEN CAMPUS, NAKORNPATTHOM PROVINCE, THAILAND

MASMEATATHIP R.*, GILLES J.** , KETAVAN C.* & DUVALLET G.***

Summary:

The seasonal changes and the daily activity of Stomoxyine species (Diptera: Muscidae) were examined, using Vavoua traps, in a dairy and a beef cattle farm in Nakhonpathom province, Thailand during July 2004 to June 2005. Over this period, *Stomoxys calcitrans* was the most commonly trapped species, followed by *S. sitiens* and *S. indica*. For the later species, this is the first report of its presence in Thailand. A total of 80 % of flies were captured during the rainy season from May to October and 20 % during the dry season from November to April. No major difference of fly density was observed between the dairy and the beef cattle farm. The activity pattern of *S. calcitrans* was diurnal with a peak between 08:00 am to 10:00 am and another less marked one in the afternoon. The activity pattern of *S. sitiens* and *S. indica* was mainly crepuscular with 2 peaks, early in the morning (06:00 am) and late in the afternoon (6:00 pm). Those species are important pests of livestock in Thailand, where they are known as a mechanical vector of trypanosomes. A better knowledge of their ecology is a prerequisite for more efficient control measures.

KEY WORDS : *Stomoxys calcitrans*, *Stomoxys sitiens*, *Stomoxys indica*, Diptera, Muscidae, Vavoua trap, seasonal abundance, activity pattern, Thailand.

Résumé : PREMIÈRE ÉTUDE SUR L'ACTIVITÉ SAISONNIÈRE ET JOURNALIÈRE D'ESPÈCES DU GENRE *Stomoxys* spp. (DIPTERA : MUSCIDAE) SUR LE SITE DE KAMPHAENGAEN, PROVINCE DE NAKORNPATTHOM, THAILAND

Une enquête sur l'activité saisonnière et journalière d'espèces du genre *Stomoxys* (Diptera : Muscidae) a été réalisée à l'aide de pièges Vavoua dans deux fermes d'élevage bovin, l'une laitière l'autre bouchère, en Thaïlande de juillet 2004 à juin 2005. Pendant la période de l'enquête, *Stomoxys calcitrans* a été l'espèce la plus abondante, suivie par *S. sitiens* et *S. indica*. Pour cette dernière espèce, c'est la première fois que sa présence est signalée en Thaïlande. Au total, 80 % des mouches ont été capturées pendant la saison des pluies de mai à octobre et 20 % pendant la saison sèche de novembre à avril. Nous n'avons pas observé de différence importante de densité de stomoxes entre les fermes laitière et bouchère. Le cycle d'activité de *S. calcitrans* était diurne avec un pic principal entre 8 h 00 et 10 h 00 et un autre, moins marqué, dans l'après-midi. Le cycle de *S. sitiens* et *S. indica* était essentiellement crépusculaire avec deux pics, l'un très tôt à 6 h 00 et l'autre en fin d'après-midi à 18 h 00. Ces espèces sont une nuisance importante pour le bétail en Thaïlande, où elles sont un des vecteurs mécaniques des trypanosomes. Une meilleure connaissance de leur écologie est indispensable pour proposer des méthodes de lutte plus efficaces.

MOTS CLÉS : *Stomoxys calcitrans*, *Stomoxys sitiens*, *Stomoxys indica*, Diptera, Muscidae, piège Vavoua, activité saisonnière, activité journalière, Thaïlande.

18 different species are known in the genus *Stomoxys* (Zumpt, 1973). Among them 17 have a tropical distribution and one *Stomoxys calcitrans* (Linnaeus, 1758), known as the stable fly, is cosmopolitan. *Stomoxys* spp. (Diptera: Muscidae) are blood-sucking muscid flies associated with domestic and wild animals throughout the world, and sometimes human beings (Moon, 2002; Wall & Shearer, 1997, 2000). High level density of flies can lead to significant reductions in weight gains of livestock (Campbell *et al.*, 1977, 2001; Wieman *et al.*, 1992) and milk production (Bruce

& Decker, 1958; Miller *et al.*, 1973). These pests of cattle cause notable economic losses and several studies have attempted to estimate their economic impact on cattle production (Catanguí *et al.*, 1997). They represent a serious nuisance not only because of their painful bites and the blood predation, but they can also be vector of pathogens (Zumpt, 1973; Foil *et al.*, 1983; Skidmore, 1985; Freitas & Romero, 1991; D'Amico *et al.*, 1996; Melo *et al.*, 2001; Foil & Gorham, 2003).

No study on the dynamics of Stomoxyine populations has been conducted in Thailand, eventhough they are suspected there to be an important vector of animal trypanosomoses by the local authorities. Due to a favourable hot and humid climate, stable flies and other Stomoxyine species are present in all livestock farms. Yet no information is available about their presence in more remote areas in contact with wild fauna.

To control vector populations and reduce their pathogenic and economic impacts, thorough knowledge of their biology and ecology is necessary. Thus, a research

* Department of Entomology, Kasetsart University, Bangkok 10900, Thailand.

** Institut für Vergleichende Tropenmedizin und Parasitologie, Dept. of Comp. Tropical Medicine and Parasitology, Leopoldstraße 5, D-8080 München, Germany.

*** UMR 5175 CEFE (Centre d'Écologie Fonctionnelle et Évolutive), Université Paul-Valéry Montpellier III, F-34199 Montpellier Cedex 5, France.

Correspondence: Gérard Duvallet.

E-mail: gerard.duvallet@univ-montp3.fr

project has been set up in Thailand to study the flies of the genus *Stomoxys* in the field. The objectives of this work were: 1) an inventory of the species of *Stomoxys* present in beef and dairy cattle feedlots in the vicinity of Bangkok; 2) an evaluation of the population dynamics as well as the daily activity; and 3) to seek which climatic parameters can be related to their population density.

MATERIALS AND METHODS

STUDY AREA

This research was conducted in a beef and dairy cattle farm in Suwanvajokkasikit Animal Research and Development Institute (SARDI) in Kamphaengsaen Campus of Kasetsart University, Ban yang district, Nakornpathom province (14° 01' N, 99° 58' E), about 90 km West from the city of Bangkok (Thailand). The site is located in a plain surrounded by grassland, perennial plants and rice fields. The beef and dairy cattle farms housed 380 and 123 cattle respectively. In this area the year is usually divided in three different seasons: wet season from June to October, dry season from November to February and hot season from March to May. Temperature, relative humidity, rainfall and radiated sunshine data were obtained from Kamphaengsaen Meteorological Station.

TRAPPING METHOD

The Vavoua trap (Laveissière & Grébaud, 1990) used in this study was first designed for tsetse fly, but it is now largely used also for the capture of stable flies (Mihok *et al.*, 1995; Gilles, 2005a).

DAILY ACTIVITY AND SEASONAL ABUNDANCE

Adult flies were captured with Vavoua traps during 24 hours every two weeks from July 2004 to June 2005. Fly specimens were collected every two hours at 06:00, 08:00, 10:00, 12:00, 14:00, 16:00 and 18:00 hrs (local time) respectively. The traps were left operational during the night until 06:00 am. The number of flies were recorded by collection hour, killed in a freezer and preserved in 95 % ethyl alcohol. They were identified to species level in the lab in Bangkok according to Zumpt (1973). The number of flies was then recorded by date, species, sex and hour of capture.

RESULTS

Three different species of *Stomoxys* were identified during this investigation: *S. calcitrans* (L., 1758), *Stomoxys sitiens* Rondani 1873 and *Stomoxys indica* Picard 1908.

CLIMATIC PARAMETERS

The main climatic parameters recorded at Kamphaengsaen Meteorological Station are presented in the figure 1. Few variations were observed all along the year, which is typical of a tropical climate. During the period of this field survey, wet rainy season was observed from July to October 2004, while dry season was from November 2004 to April 2005 with a rain in March 2005, and a new rainy season beginning in May 2005.

DAILY ACTIVITY

The daily activity of the different species was quite similar in the beef and dairy farms (Fig. 2). The figure 2 shows the number of flies captured per period of two hours during all the year under survey. No difference was observed between males and females and the results have been grouped for both sexes. For *S. calcitrans*, a major peak was observed between 08:00 am to 10:00 am and a smaller one around 04:00 pm. For *S. sitiens* and *S. indica*, there was a peak of activity in the evening, 06:00 pm to 06:00 am (next day) and another one in the morning, 06:00 am to 08:00 am.

POPULATION FLUCTUATIONS

The monthly captures are shown in Table I where the numbers indicate the total of flies captured in two days per month at each farm. For the total number of flies trapped during this period, it was found that 80 % of flies were captured during the rainy season (July to October 2004 and May to June 2005) and 20 % during the dry season (November 2004 to April 2005). Only two *S. calcitrans* were captured in March from dairy cattle farm, but after the first rain during this month, the total number of flies increased to 17 in April, and only 9 in May. However, at the beginning of rainy season in June, the number of flies captured in dairy cattle farm increased notably (Table I). During all the survey period, only the number of males *S. calcitrans* was slightly greater than those of females (Table II). For the other species, the number of females was obviously exceeded the number of males. *S. calcitrans* was the most common species with 62 % of captures, followed by *S. sitiens* (28 %) and *S. indica* (10 %).

DISCUSSION

S. calcitrans, *S. sitiens* and *S. indica* have been identified during this survey. *S. calcitrans* was found in great number while *S. indica* was reported to be found for the first time in Thailand. *S. calcitrans* is a cosmopolitan species, which has followed human beings during their peregrinations everywhere in the world, from the tropical to the temperate and even cold areas. Its origin was probably the Oriental region (Zumpt, 1973) and not in the Ethio-

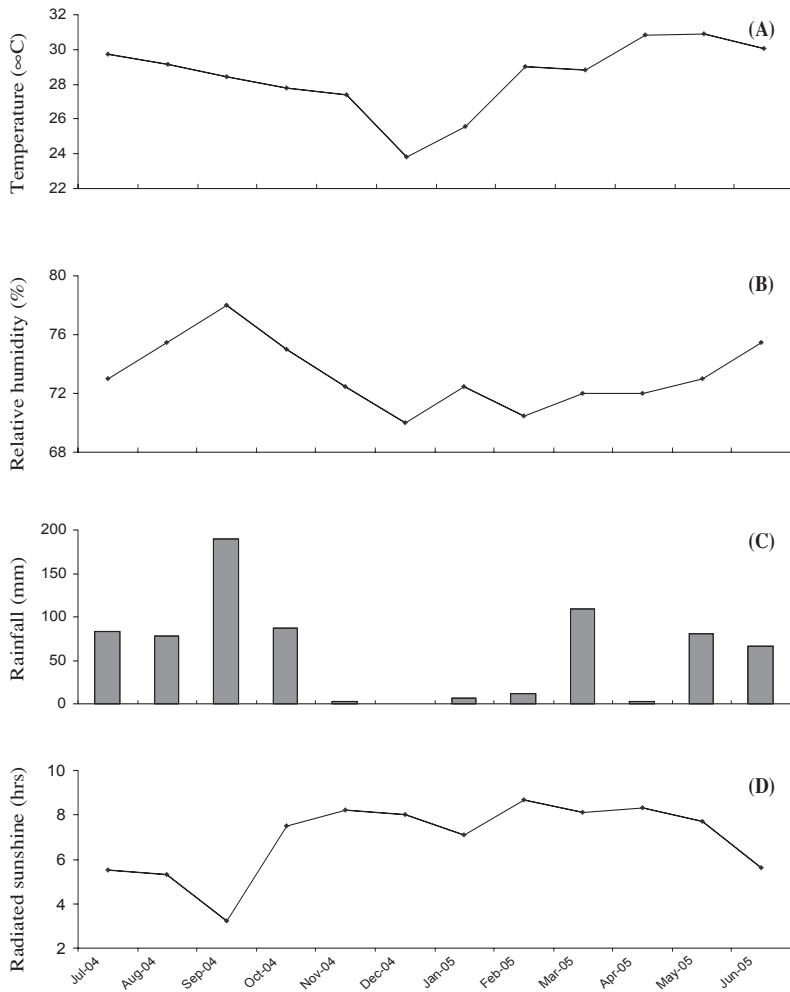


Fig. 1. – Monthly mean ambient temperature (A), relative humidity (B), rainfall (C) and radiated sunshine (D). Data obtained from Kamphaengsaen Meteorological Station.

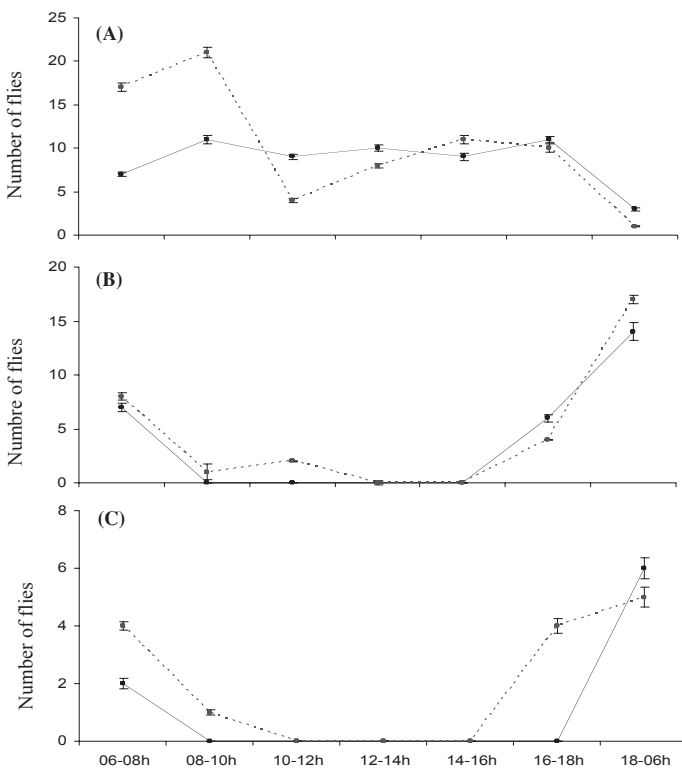


Fig. 2. – Daily activity of *S. calcitrans* (A), *S. sitiens* (B) and *S. indica* (C) in a beef farm (plain line) and a dairy farm (dotted line), observed at Kamphaengsaen Campus, Nakornpathom province, Thailand. The number of flies is the total number captured during the survey period.

Sites	Year	Months	<i>S. calcitrans</i>	<i>S. sitiens</i>	<i>S. indica</i>	Total
Beef cattle farm	2004	July	17	1	0	18
		August	16	0	0	16
		September	17	11	4	32
		October	4	5	1	10
		November	0	0	0	0
	2005	December	1	0	0	1
		January	1	0	0	1
		February	1	1	3	5
		March	0	0	0	0
		April	0	7	0	7
		May	0	1	0	1
		June	3	1	0	4
		Total		60	27	8
Dairy cattle farm	2004	July	7	2	0	9
		August	4	1	0	5
		September	2	4	0	6
		October	16	1	4	21
		November	0	1	0	1
	2005	December	6	1	0	7
		January	1	0	0	1
		February	4	2	1	7
		March	2	0	0	2
		April	1	8	1	10
		May	5	3	0	8
		June	24	9	8	41
		Total		72	32	14

Table I. – Monthly catches of *Stomoxys* spp. in a beef and a dairy cattle farms, Kamphaengsaen Campus, Nakornpathom province, Thailand from July 2004 to June 2005.

Sex	<i>S. calcitrans</i>	<i>S. sitiens</i>	<i>S. indica</i>
Male	68	23	8
Female	64	36	14

Table II. – Number of males and females flies observed during the survey period (July 2004 to June 2005) at Kamphaengsaen Campus, Nakornpathom province, Thailand.

pian region, as usually thought. In support of these findings, a biogeographical study of this species started in our laboratory to know its cradle and the way it has invaded the world and phylogeographic studies performed on 37 different populations from all the biogeographical regions of the world seem to confirm this hypothesis (Porco *et al.*, unpublished data).

S. sitiens has been recorded from many places in the Ethiopian region from the Gambia to South Africa and Egypt, but this species is very rare in collections. It occurs also in the Oriental region from India to the Philippines, but the material is as rare as that from Africa (Zumpt, 1973). And few data on its biology are available (D’Amico *et al.*, 1996).

S. indica is a variable Oriental species, with many synonyms in the entomological literature. It has been recorded from many countries in this region, from India and Sri Lanka in the West to Samoa Island in the East (Zumpt, 1973). This paper is the first report on the occurrence of *S. indica* in Thailand. *S. indica* is des-

cribed to be the most common *Stomoxys* species in the Oriental region after *S. calcitrans*. But during this survey only 22 *S. indica* were captured, against 59 *S. sitiens* and 132 *S. calcitrans*. That means that during the period of the survey and using the Vavoua trap, *S. sitiens* seems more abundant than *S. indica* in this area.

DAILY ACTIVITY

Concerning the daily activity, despite the low number of captured flies, their activity could be easily observed among the three species. For *S. sitiens* and *S. indica*, the peaks observed showed that the activity was highest at sunset and dawn. On the opposite, *S. calcitrans* showed an activity all along the day with a peak between 08:00 am to 10:00 am. It was already reported (Kano, 1953 in Zumpt 1973) that *S. indica* seemed “to be active in the evenings, as they are readily collected by the light-trap”. It seems that the crepuscular activity of some *Stomoxys* species could have limited their capture, explaining their scarcity in the collections. Most of the authors who have published about the activity of those flies worked on *S. calcitrans* only. Bimodal feeding activity patterns for stable flies were reported by Mitzmain (1913), Simmonds (1944), Labrecque *et al.* (1975), Kunz & Monty (1976), and Charwood & Lopes (1980). In contrast, Coaker & Passmore (1958) and Harley (1965) observed uniform or unimodal feeding activity patterns through the day-

light hours. Berry & Campbell (1985) found that the pattern of daily activity of *S. calcitrans* was affected by temperature, humidity and the level of solar radiation, while Patterson *et al.* (1981) reported that direct solar radiation increased the internal temperature of resting stable flies up to 14.8°C above ambient temperatures and that the flies preferred shaded resting areas when their internal temperatures reached 31 to 34°C.

ABUNDANCE OF FLIES

During the entire survey, the total abundances recorded were quite similar in the beef and the dairy cattle farms with 95 and 118 *Stomoxys* spp., respectively. Globally, the most important captures were made during the warm and rainy season for all the species in both farms but these values were relatively low in comparison with others studies (Gilles, 2005; Lysyk, 1993; Guo *et al.*, 1998; Heath, 2002; Guglielmone *et al.*, 2004). It appears difficult to explain these low values by the climatic parameters. Indeed, during this season, with: *i*) monthly rainfalls between 80 and 180mm, *ii*) monthly relative humidity between 72 and 80 %, and *iii*) monthly mean temperatures ranged from 27 to 30°C, we expected to observe a positive rate of increase of the Stomoxyine populations (Lysyk, 1998; Gilles *et al.*, 2005b, 2005c). Otherwise, the potential use of insecticides or anti-parasite drugs by the farmers during the survey could explain the low densities of flies, but it was impossible to get information about animal treatments. Another possibility could be an interspecific competition for the larval resources between the *Stomoxys* populations and the high densities of *Haematobia irritans* observed during the survey or maybe the presence of enemies like parasitoids or entomopathogenic fungi in these environments.

Furthermore, the quasi disparition of the Stomoxyines, from November 2004 to February 2005, could be explained by the very low rainfalls and still relatively high temperatures (ranging from 24 to 29°C), resulting in a drying of larval developmental sites.

S. calcitrans was the predominant species but in regard to the results of the daily activity, *S. sitiens* and *S. indica* seem to have a crepuscular activity so it will be necessary to find an adequate trapping method for these two species.

For the sex ratio difference observed for *S. sitiens* and *S. indica*, this could be explained by a different behaviour of both sexes. Other observations are necessary to investigate that point.

CONCLUSION

The health and economic impacts of Stomoxyine flies on livestock are more and more recognized. All the available information comes from

North and South America with *S. calcitrans* as a model. But several research projects have now been implemented in different other countries to make an inventory of the different species and to get more knowledge of their biology. This first report from Thailand has shown that three different species of *Stomoxys* were present in the beef and dairy farms studied near Bangkok. *S. indica* has been identified for the first time in this country. The study of the daily activity has shown that *S. calcitrans* had a more diurnal activity, and *S. sitiens* and *S. indica* presented a peak of activity at dawn and at sunset. The three species are more abundant during the rainy season. The research project will continue in different other regions of Thailand to study *Stomoxys* species, but also other Stomoxyine flies like *Haematobia* spp. which are also abundant.

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