Short Communication

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# *Stomoxys calcitrans* as possible vector of *Trypanosoma evansi* among camels in an affected area of the Canary Islands, Spain

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**ABSTRACT**

**Introduction**: *Trypanosoma evansi* was first identified in the Canary Islands in 1997, and is still present in a small area of the Archipelago. To date, the disease has exclusively affected camel herds, and has not been detected in any other animal hosts. However potential vectors of *Trypanosoma evansi* must be identified. **Methods***:* One Nzi trap was placed on a camel farm located in the infected area for a period of one year. **Results***:* Two thousand five hundred and five insects were trapped, of which *Stomoxys calcitrans* was the sole hematophagous vector captured. **Conclusions***: Stomoxys calcitrans* could be exclusively responsible for the transmission of *Trypanosoma evansi* among camels in the surveyed area, as other species do not seem to be infected by *S. calcitrans* in the presence of camels.

**Keywords:** *Trypanosoma evansi. Stomoxys calcitrans*. Stable flies

*Trypanosoma evansi (T. evansi)* causes the disease known as surra and is the most widely distributed of the pathogenic animal African trypanosomes, affecting domestic livestock and wildlife in Asia, Africa, and Latin America. *T. evansi* infects a number of domesticated animals, but the principal host species varies across the affected continents. Buffalo, cattle, camels, and horses are particularly susceptible, although other animals including wildlife can also be infected[1].

The mechanism of *T. evansi* transmission is biting flies, including species other than tsetse, as well as by vampire bats in South America. Further, many blood-sucking insects, especially horse flies (*Tabanus* spp.) and stable flies (*Stomoxys* spp.) can transmit *T. evansi* from one infected host to another.

*Trypanosoma evansi* was first identified in the Canary island in 1997 in a camel that presented the chronic stage of surra. Since, a program for control and eventual eradication of the disease was established based on the detection, isolation, and treatment of infected animals. Presently, the disease is considered eradicated from many islands and areas of the Archipelago, except in a small area of Gran Canaria island, where *T. evansi* remains active[2]. Two hypotheses have been proposed to explain the sustained survival of *T. evansi* in this limited area. One explanation is the lack of trypanocide efficacy and subsequent resistance and relapse of infection, while a second is the presence of a reservoir in the affected area that results in continued re-infection. To evaluate the latter possibility, our group assessed wild rodents[3], domestic ruminants[4], and equines[5] as possible reservoirs, but *T. evansi* was not detected in any of the animal populations that were sampled.

Surra has been present in the camel herds in the Canary Islands for greater than 10 years, but clinical evidence of natural infection has not been identified in other animal species that inhabit the surrounding areas. Thus, ruminants and equines located in the affected area have apparently not been infected. The absence of clinical signs associated with surra supports these results. Conversely, it has been demonstrated that the *T. evansi* strain present in the Canary Islands affects animal species other than camels, as it has been detected following the outbreaks that occurred in equines in mainland Spain in 2008[6], as well as in the sheep outbreak that occurred in metropolitan France[7] after the import of infected camels from the Canaries.

Given the collective facts, the purpose of our study was to identify insects that could act as potential vectors of the disease.

One multipurpose trap for designed for the capture of biting flies (Nzi trap model)[8] was used in this study given the high efficacy demonstrated by the trap for catching the most common biting flies in the livestock environments outside Africa,

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including horse flies (*Tabanidae*)[9] and stable flies (*Muscidae: Stomoxyinae*)[10]. The trap was placed within one of the camel farms located in the affected area, and was maintained for 12 months (July, 2010 through June, 2011). Insects were collected twice per week and preserved with ethanol until identification. All insects caught in the trap were counted, and the different potential vector species for *T. evansi* were isolated and identified.

Regarding possible mechanisms of *T. evansi* transmission in the surveyed area, the multipurpose trap resulted in the successful capture of biting as well as other non-biting flies. *Stomoxys calcitrans* (Linnaeus) was the only potential vector for *T. evansi* among the different dipterous species that were captured through the year the study was conducted **(Figure 1)**. Of a total of 2,505 dipterous captured, 993 were *S. calcitrans*. During the entire period of capture, the number of *S. calcitrans* trapped was always lower than the number of non hematophagous dipterous species captured, except in the month of November. Further, no tabanids, *Atylotus* spp. or *Haematobia* spp. (synonymous *Lyperosia* spp.) were found.

The fact that *T. evansi* remained active in camel farms, and yet the ruminants and equines living in the surrounding areas were apparently not affected could be explained by the presence of particular vector/s with specific feeding behaviors. *Stomoxys calcitrans* and *Tabanus* spp. have been implicated in the outbreaks that occurred in continental Europe[6,7], and are frequently cited in the literature as common vectors; however, specimens belonging to the *Tabanidae* family were not trapped in our area included in the current study.

*Stomoxys* spp. (*Muscidae*) have been reported to exhibit heterogeneous feeding patterns within a host species. As well, field studies have consistently indicated that carbon dioxide is an important kairomone for *Stomoxys*[11]. Camels are not considered true ruminants, and have been included in the suborder Tylopoda, which is separate from the suborder Ruminantia. However, the annual production of methane for a camel has been estimated as 58kg, while cattle and horses are estimated to produce 45kg and 18kg, respectively[12]. Collectively, camels, cattle, and horses could be responsible for the production of approximately 1.3, 1.0, and 0.4 tons of carbon dioxide per year, respectively. Accordingly, the higher carbon dioxide production of camels compared to production by ruminants and equines could have contributed to maintenance of the *Stomoxys* population within the camel environment. Moreover, the absence of *Tabanidae* (horseflies) in the area, an insect that typically feeds on horses and is known to be an efficient transmission vector[13], likely contributed to the protection of equines from infection.

From the epidemiological viewpoint, one of the most important parameters for controlling a vector-borne disease is the biting rate of the vector, which is defined as the reciprocal of the period of time between successive bloodmeals[14]. Conversely, the survival of trypanosomes outside the hosts depends on the species of vector involved, and could be a limiting factor in the mechanisms of transmission. In any case, unlike in horseflies, the mouthparts of stable flies do not facilitate the long-term survival of parasites. It has been reported that motile and presumably viable *T. evansi* remained in the proboscis of *Stomoxys* spp. for approximately 5-7min after feeding[15], which could explain why *T. evansi* has been maintained within the camel herds without apparent infection of other surrounding livestock.

In conclusion, the results of the current study indicated that *S. calcitrans* would be the sole vector implicated in the transmission of *T. evansi* in the endemic area of the Canary Islands. Further, it appeared that *S. calcitrans* specifically

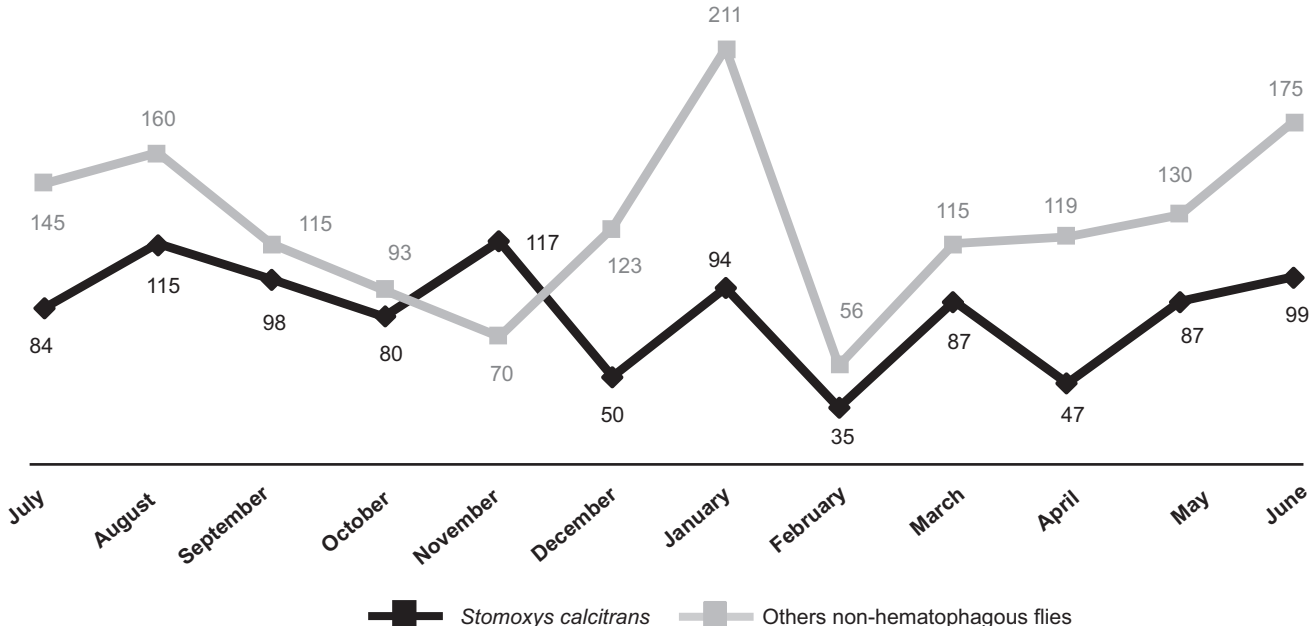


**FIGURE 1 - Number of *Stomoxys calcitrans* and other non hematophagous flies captured during the trapping period.**

affected the camel population and no other species, including equines, which are another highly susceptible animal species inhabiting the same area. Control measures against *S. calcitrans* must be implemented in order to minimize the impact of this potentially important vector in the local area as well as its role in the transmission of the surra.

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## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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